EXHIBIT 4

MCI/QUANTEL

Micro Consultants, Inc., P.O. Box 50810, Palo Alto, California 94303, Phone: (415) 856-6226, Telex: 334420

NEWS

March 16, 1981 DAVE DEVER
(203) 348-4104

PRELIMINARY DESCRIPTION

The DLS 6000 Series Digital Library System

Summary

The Quantel DLS 6000 Series includes three NTSC broadcast systems that permit recording of still pictures in digital form on standard computer industry disc drives. The DLS 6010 is a basic still-store system. The DLS 6020 includes on-air transition capabilities. The DLS 6030 includes production effects capabilities. Both the 6010 and 6020 are upgradeable to full 6030 capability at any time.

Common to all three units are:

* Compact - basic electronics occupy only 10½" of rack space
* Modular and expandable
* Small, reliable Winchester-type disc drives
* Standard SMD disc drive interface
* Up to 800 pictures per disc drive
* Up to eight disc drives per system
* Versatile control panel operation
* Multi-station control capability
* Economical digital videotape backup system (optional)

System Highlights

DLS 6010 BASIC STILL-STORE SYSTEM

* Asynchronous picture freeze
* Field/frame record
* Picture grab
* Picture erase
* Picture protect

System Highlights (continued)

DLS 6020 ON-AIR TRANSITION SYSTEM

Includes all the features of the DLS 6010 plus:

* Three independent video outputs (preview and two program)
* On-air picture change
* On-air transitions (cuts, dissolves, wipes)
* On-air editing
* External key recording for captions

DLS 6030 PRODUCTION EFFECTS SYSTEM

Includes all the features of the DLS 6020 plus:

* Picture reposition
* Picture compression
* Picture cropping
* Variable picture aspect ratio
* Multiple picture build-up (montages)
* Border/matte generation
* Titling call-up
* "BROWSE" picture search

THE DLS 6000 SERIES DIGITAL LIBRARY SYSTEM

Introduction

The revolutionary Quantel DLS 6000 Series Digital Library System represents a new generation of still-store devices that use a computer disc rather than 35 mm slides for picture storage.

One of the many advantages of the system architecture is complete modularity. The smallest unit in the series, the DLS 6010, can be upgraded at any time to 6020 or 6030 status. Similarly, the intermediate DLS 6020 can be upgraded to 6030 status. This continues the Quantel tradition of system modularity, allowing the addition of capabilities as requirements change or budget considerations permit.

The modular architecture will also allow DLS 6000 users to take advantage of the latest advances in Winchester-type disc technology. Although selected disc drives are being offered initially, the incorporation of a standard computer industry SMD (Storage Module Drive) interface means that any drives developed in the future with this interface can be used with any DLS 6000 Series system.

Adding further flexibility and economy to the system is a special off-line tape storage system that allows images to be stored on conventional videotape in digital form. With this optional system, data can be interchanged from disc to disc or a large archival library can be kept on videotape.

The Basic Philosophy

The idea of storing TV stills on a computer disc in digital form is not new. Advantages include high integrity of information, very simple generation of stills,ease of program compilation with greater immediacy, lower operating and maintenance costs, and better security.

The philosophy behind the DLS 6000 Series is the marriage of solid-state framestore techniques with standard computer disc technology. Emphasis has been placed on using completely unmodified computer disc systems to lean on the experience gained in the large market base of the computer industry.

The technology chosen for the storage medium is the Winchester-type disc. This sealed device allows very high packing densities (with up to 800 pictures stored on one disc). Yet the disc drive occupies just a few inches of rack space.

The disk operates at relatively low data rates. Thus a basic computer-based still-store system must include the disc itself and a solid-state framestore able to operate at both real time video rates as well as the disc data rate. In spite of the disc data rate being lower than the full video sampling frequency, no inconvenience results since pictures can still be accessed at rates of two per second.

The basic task of the system is then to record and replay pictures correctly on the disc. This requires just a single framestore, as in the DLS 6010. However, considerable improvement in flexibility is possible if more than one framestore is included. Thus the DLS 6020 and 6030 include three.

The usefulness of the system can be further enhanced if, at the same time, the size and position of the replayed picture can be defined in accordance with the requirement of the rest of the production. This is possible with the DLS 6030. Special circuitry in the DLS 6030 also allows this function to be available for multiple images, permitting the production of montages. A multiple border generating facility completes the full production package of the DLS 6030.

Another feature -- optionally available on all DLS 6000 Series units -- is a videotape backup system. This allows pictures to be stored in digital form on a conventional VTR, cassette or reel-to-reel, resulting in great flexibility and simple interchange of information between one installation and another.

The System

Figure 1 is a block diagram of the DLS 6010 Basic Still-Store System.

The recording chain is shown at the top. Input video enters the system and is immediately converted into digital format and passed to a framestore at full video data rates. The input framestore acts as a freeze frame device and allows the user to select still pictures from the incoming live video.

The input section of the machine can operate asynchronously with respect to the output, thus removing the requirement for a synchronizer for the input video.

Once the chosen image has been frozen in the framestore, it is read out at disc data rate via a data processor section to further reduce data rates. It is then passed to the disc formatter for disc format blocking and written onto the disc.

The disc itself is the latest generation Winchester-type sealed unit with high packing density. Two versions are currently available -- one with a capacity of 340 pictures, the other with 800. Read-write heads are of the flying type but the design of the disc eliminates the need to have expensive head retraction mechanisms. The heads actually land on the disc surface when the platter is not in motion. The disc data rate allows a picture to be generated in 500 milliseconds. The package is highly reliable and rugged. Parity check circuitry is included for optimum data integrity.

The system link with the disk is via the industry - standard SMD interface. It is anticipated that new disc drives will conform to this standard for some time to come. Thus users of DLS 6000 Series systems will always be able to take advantage of the latest storage technology.

The replay chain is shown at the bottom of Figure 1. Data from the disc passes through a disc re-formatter to the framestore. It then is transferred at full video rate into a DAC and onto the display via a proc amp.

The tape backing store system is interfaced to the disc before and after the disc formatter and de-formatter. Information on disc has to be prepared and re-blocked by the tape formatter prior to the addition of syncs and burst for feeding to the tape system. It should be remembered that the tape system is perfectly conventional. Any recorder available in the studio or van will suffice.

When receiving information from the tape backing store, information is unpacked in a tape de-formatter before being passed on to the disc.

Figure 2 shows the block diagram of the DLS 6020 On-Air Editing System and the DLS 6030 Production Effects System.

The recording chain is the same as for the DLS 6010, described above.

The replay chain is more complex because of the two additional framestores and program output facilities.

After data from the disc passes through the disc re-formatter, it goes to one of the three framestores available (in the case of the DLS 6030, it first passes through a data processor). If the information is routed via the preview store, no other processing is done other than reading it out of the store at full video rate into a DAC and onto the display via a proc amp. If the data is fed to one of the program stores, then it is subsequently passed to a digital combiner assembly that performs the appropriate wipe, cut, or dissolve functions. The combiner also copes with the addition of borders or the keying of caption information over pictures or colored mattes.

The input framestore and the preview output are one and the same device since at no time is there a requirement for the two to operate simultaneously. For simplicity, this link has not been shown in the diagram. Also not shown is the host minicomputer that controls the entire system and is responsible for all housekeeping tasks, the operation of the control panel and the editing system.

The tape backing store system is exactly the same as for the DLS 6010 described earlier.

The DLS 6010 Basic Still-Store

The DLS 6010 comprises just the one framestore shared between the input and output sections of the machine.

The 6010 thus is really a simple freeze picture device with the ability to store the frozen pictures on disc for recall on demand. The best analogy is of a very basic slide scanner augmented with the ability to capture live incoming information.

As with all versions of the 6000 Series, the tape backing store system is available as an optional extra.

Since no size changing mechanisms or on-air program changes are permitted in this configuration, the replay chain is greatly simplified.

Facilities offered by the DLS 6010 are as follows:

Capacity

Dependent on disc used but currently up to 800 pictures on one disc unit (one picture defined as 1 TV field, for storage of TV frames numbers should be halved).

Number of Discs handled

With optional interface cards, the DLS 6010 has built-in capability of handling up to 8 discs at one time. Numbers higher than 8 require a separate interface box.

Change Rate

Pictures can be changed at a rate of two per second with complete random access.

Asynchronous Picture Capture

The input of the DLS 6010 can handle asynchronous information to allow stills to be captured from incoming remotes.

Field/Frame Freeze

Pictures can be recorded in either field or frame resolution. Typically, "stop motion" will always be recorded in field mode while caption information will use the frame mode. In order to make maximum use of the available disc, a field mode picture occupies half the space of its frame mode equivalent. Field mode and frame mode can be intermixed at will on the disc.

Picture Grab

In normal operation incoming pictures that have been frozen are not put on to disc automatically. The transfer has to be specifically requested by pushing the record button.

An additional mode of operation exists that is more analogous to a 35 mm camera with "auto wind". This mode, "picture grab", allows incoming pictures to be automatically frozen and recorded on a reserved buffer area of the disc until the operation is terminated or the buffer is full. This enables the operator to grab large numbers of live action shots rapidly as the event is happening, then later edit the disc to specifically erase unwanted shots.

Picture Erase

Single pictures may be erased on disc without affecting those stored on adjacent tracks.

Write Protect

The record mechanism is locked out from overwriting tracks already recorded until they have been specifically erased. ERASE is protected by a two button interlock.

In addition an overall "write protect" hardware interlock is fitted to the disc. When activated, this prohibits all recording and erasing processes.

Tape Back-up Store

The tape back-up storage system is available as an optional extra for the 6010.

The DLS 6020 On-Air Editing System

The DLS 6020 offers the full three framestore facilities but stops short of the processing ability of the fully configured DLS 6030.

Thus the 6020 is analogous to a sophisticated slide scanner that contains two slide carriers and permits on-air changes.

The facilities offered by the 6020 are exactly as described earlier for the 6010 but with the following additions:

Multiple Output

Three outputs are available (two program and one preview), all independent of one another so that, if required, transitions can be effected between the two program outputs.

On-Air Picture Change

Although the change rate is limited to two per second, the additional framestore circuitry in the 6020 allows vertical interval switching between pictures. Thus the switch is instantaneous.

On-Air Transitions

A mix/effect bus can be eliminated by utilizing the digital transitions available. Changes between one picture and the next can be by means of a cut, a programmable dissolve, or even a wipe.

On-Air Editing

The on-air display or transition is unaffected by the contents of the preview store. Similarly, the 6020 allows the capture and recording of incoming material during on-air display or transitions. This feature allows the unit to be used to its fullest extent in the news studio.

Captioning

Facilites are provided for recording an external key along with caption information. On command, the 6020 will automatically key the caption over another still.

The DLS 6030 Production Effects System

The DLS 6030 not only represents a sophisticated slide scanner but also combines many features found in a switcher and digital effects unit.

The 6030 includes all the capabilities of the 6010 and 6020 with the following additions:

Picture Reposition

The output picture of the DLS 6030 can be repositioned by the technical director at will.

Picture Compression

The DLS 6030 will reproduce the stored image at any size from normal (full size) down to virtually zero size. This feature, together with the reposition system, allows the director to define the exact size and position of the reproduced still to suit his production without resorting to any other digital effects device.

Picture Cropping

If only a portion of the still requires display, the 6030 allows the stored image to be cropped. Combining this function with those of compression and reposition allows almost unlimited freedom for picture composition.

Variable Aspect Ratio

The aspect ratio of the image can be varied at will from the standard 4 x 3 to any rectangular shape.

Multiple Picture Handling

The DLS 6030 is capable of reproducing as many pictures as are wanted at the same time. This capability is clearly an adjunct to those of compression and repositioning and is used to show at the same time a number of participants in a discussion or event, or even to build up a complete montage of images. The pictures can be recalled from disc one at a time to show the viewer the build up, or simultaneously so that only the finished composite is seen.

The Borders

The DLS 6030 includes its own border generator capable of changes in hue, saturation, luminance, and width. This is applicable to all pictures being shown, although different images can have different border parameters at the same time.

The border generator also includes a background or matte generator, further releasing the switcher for other functions.

Additional Preview Capabilites

Not only does the DLS 6030 have its own preview output which can be operated without affecting the on-air program or transitions, but it allows the varying size or position of images to be chosen by means of cross-wire cursors controlled by joysticks. It also contains a unique feature for fast viewing called "BROWSE".

"BROWSE"

"BROWSE" provides the ability to look through the contents of the disc by displaying 16 images at one time and slowly moving them down the screen. This rolling list of pictures allows easy viewing to find the desired frame, or permits the showing of pre-chosen slides waiting in the "stack" for display on a program.

Digital Re-recording of Composite Pictures

Composite pictures created on the preview monitor can either be stored as control parameters to ensure recall on demand on the program outputs, or they can be re-recorded back onto disc as a complete new picture at an individual location.

KEY

The DLS 6030 generates an output key that follows the video at all times.

In addition, if an incoming key signal is being used in conjunction with a title for captioning, the size and position change circuits operate on this incoming key signal to allow the stored caption information to be re-sized or positioned if required.

The Control System

In association with the three system configurations are various control panels offering different facilities and varying levels of complexity.

The panels have been designed so that the various sections can be added to one another as the extra facilities are required. Any panel configuration can be used with any hardware configuration. In cases where a panel contains controls for functions not fitted to a machine, those controls will merely become inoperative.

The Replay Only Panel

Figure 3 shows the replay only panel. This is an optional panel for multi-station operation. A picture is accessed by means of punching on the key pad the number of the picture on the disc, then pressing the TAKE button. The temporary register display to the right of the TAKE button will indicate the keys that have been depressed.

Once the picture is taken its title (if this had been recorded earlier) will appear on the top row of the display.

A "stack" of pictures waiting for display can be organized by simply punching the appropriate number and then pressing one of the small round buttons in the column that corresponds to the position required in the stack since it is this column that represents the "stack" with the top "high". The system allows both insert, substitution or assemble editing to take place and the slide number will ripple up the stack as the pictures are taken. In the case of the next slide awaiting display on air, its title will also be displayed.

The Record/Replay Panel

Figure 4 shows the record/replay panel. This is the standard panel that comes with every DLS 6000 series unit. In addition to the controls included on the replay only panel, the record/replay panel includes additional controls for recording and for loading/unloading the videotape back-up system.

Incoming pictures are frozen via the freeze button and captured in frame or field mode as selected by the frame button. To record the frozen picture on disc, the required picture number is keyed in, RECORD is depressed and the picture number is shown on the register at the top of the small extra panel. When "TAKE" is pressed at the same time, the record mechanism is activated.

GRAB operates the special Grab mode, and VIEW will step through all images grabbed. A picture will be grabbed and recorded automatically each time the GRAB button is depressed up to a rate of two pictures per second. Pictures will continue to be grabbed at full speed as long as the GRAB button is kept pressed.

Pictures can be erased by calling up the number and then pressing simultaneously RECORD and CLEAR.

LOAD and DUMP are associated with the tape back-up system. LOAD will initiate the transfer of information from the back-up tape to the disc and DUMP will arrange the reverse process from disc to tape. By means of the key pad the starting and stopping points for the transfer can be defined. The toggle switches marked Protect and Play/Set-up are associated with the hard write-protect for the disc and, in the case of the DLS 6010, whether the store is required to look at incoming video or the disc output.

The Production Effects Panel

Figure 5 shows the record/replay panel augmented with the production effect controls. This combination of two panels is standard with the DLS 6020 and 6030. Users of the Quantel DPE 5000 will be familiar with the concept of the production effects control since they are based on the pre-select button concept. Buttons A through K are able to store a size and position of an image. This storing process is accomplished with the aid of the two joysticks. On the preview display, the cross wires are positioned by the joysticks to define the position and size wanted; if "enter" and the required pre-select button is depressed the 6030 will then memorize those parameters. On replay, while the LED on the button is illuminated, all pictures will be produced according to the stored parameters until a different button, or the special case full size location, is pressed.

Dissolve times can be set in a similar manner, the number of frames being typed in from the keyboard. Similarly, cropping is activated by the cropping button, thus permitting the joysticks to crop rather than resize.

Border and matte facilities are also memorized in the preselect locations with the parameters being controlled by the spring levers below the joysticks.

The Keyboard

Figure 6 shows the final panel in the control system. This is a typewriter style keyboard used in conjunction with a monochrome TV screen to allow all titling and editing functions. It is standard on the DLS 6030.

Using a powerful conversational language the operator can perform all functions necessary to edit information on the disc, title the picture stored, search for pictures by title alone, sort pictures by title content, dump to and load from the tape back-up store, and prepare stacks and groups of stacks for replay by the replay only or record/replay panels.

The Tape Backing Store

The advantages of Winchester technology disc drive systems are many, not the least of which is the very small physical size and the high reliability possible even in non-clean ambient conditions that would be completely unacceptable for removable disk systems. However, in spite of all the advantages, there is the one apparent disadvantage: transferring pictures from site to site would seem difficult.

This one disadvantage is, in fact, transformed into an advantage with the optional tape backing store. This system allows the contents of the disc, or selected portions to be dumped onto tape, either reel to reel or cassette, then replayed back into a 6000 series unit at either a remote site or at the same site at a later time. In this way, the user is given all the advantages of the conventional slide carrier but with all the added facilities of the electronic system.

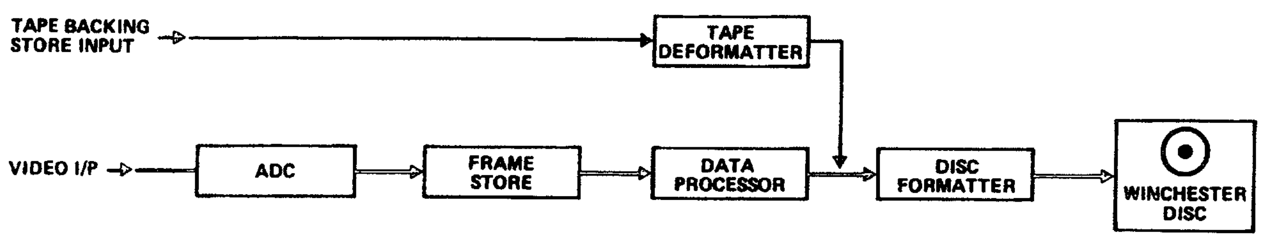
In order to maintain high flexibility the information is recorded on the tape in digital format. Thus normal "generation loss" considerations can be forgotten.

However, this technique does not require a "digital VTR": the speeds of transfer are compatible with the disc - not with raw input video. Accordingly, once sync and burst have been added to the purely artificial digital video stream, any conventional analog VTR may be used since the bandwidth of the digital train is well below that of conventional NTSC video.

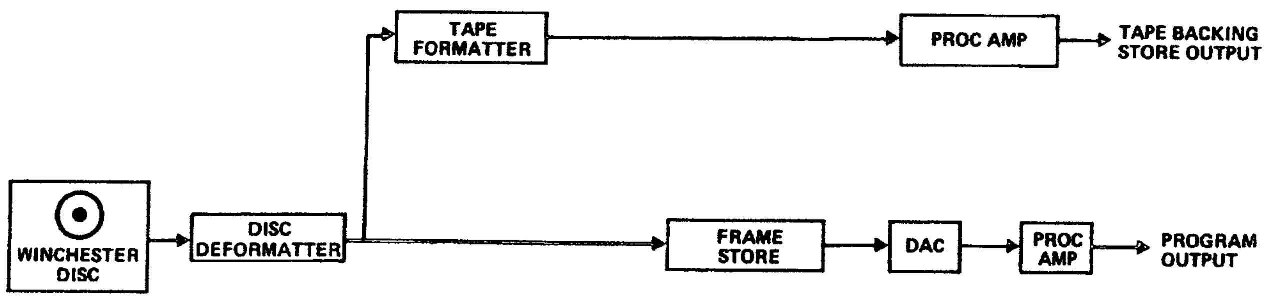
The technique is not dissimilar to the current use of cassette VTR's for very high quality digital sound. When viewed, the cassette produces a jumble of white and black dots; when decoded by the sound receiving circuits, hi-fi sound results. Similarly with the 6000 series units, if the video on tape is viewed in the conventional manner, it is meaningless, but when played back into the disc and then viewed, perfect video results.

The time to transfer a complete disc full of images ranges from six to sixteen minutes; the smaller the number of images to be transferred the shorter the time. If selecting portions of information from archival tapes, then the fast shuttle of the VTR is the limiting factor. This is considerably faster than physically changing disks.

A normal 1 hour cassette or reel-to-reel tape will hold approximately 3000 pictures so the cassette solution provides a more convenient means of transport than conventional 35 mm slides.



THE RECORDING CHAIN.



THE REPLAY CHAIN.

FIGURE 1. BLOCK DIAGRAM OF THE DLS 6010

L001371

AX022143

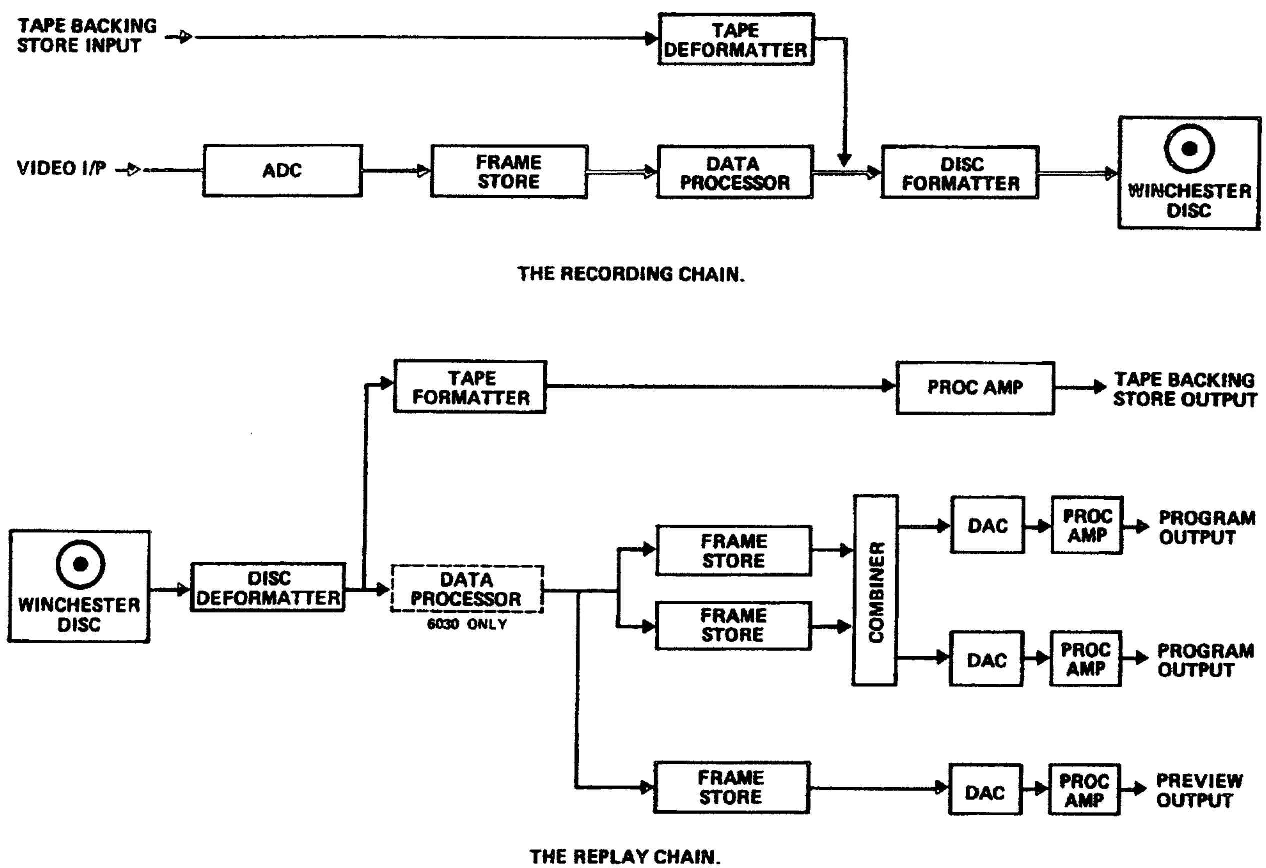


FIGURE 2. BLOCK DIAGRAM OF THE DLS 6020 AND DLS 6030

L001372

AX022144

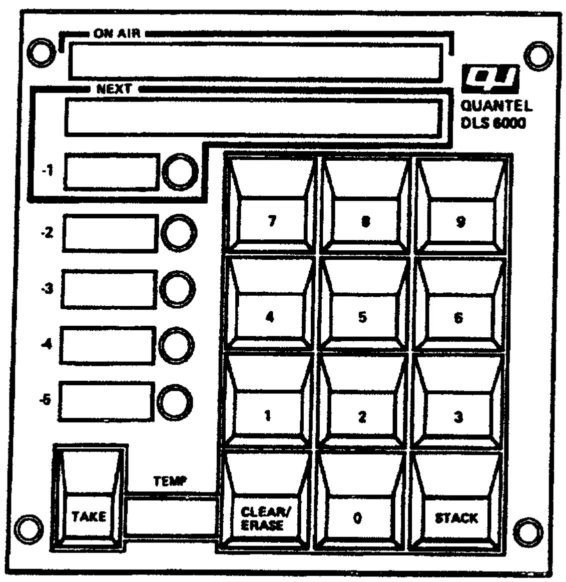


FIGURE 3. BASIC REPLAY ONLY PANEL

L001373

AX022145

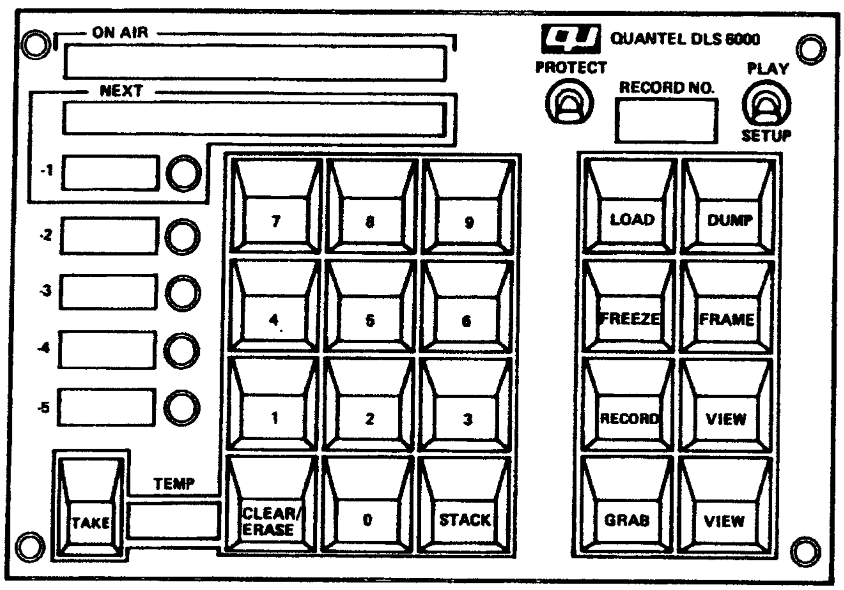


FIGURE 4. BASIC RECORD/REPLAY PANEL

L001374

AX022146

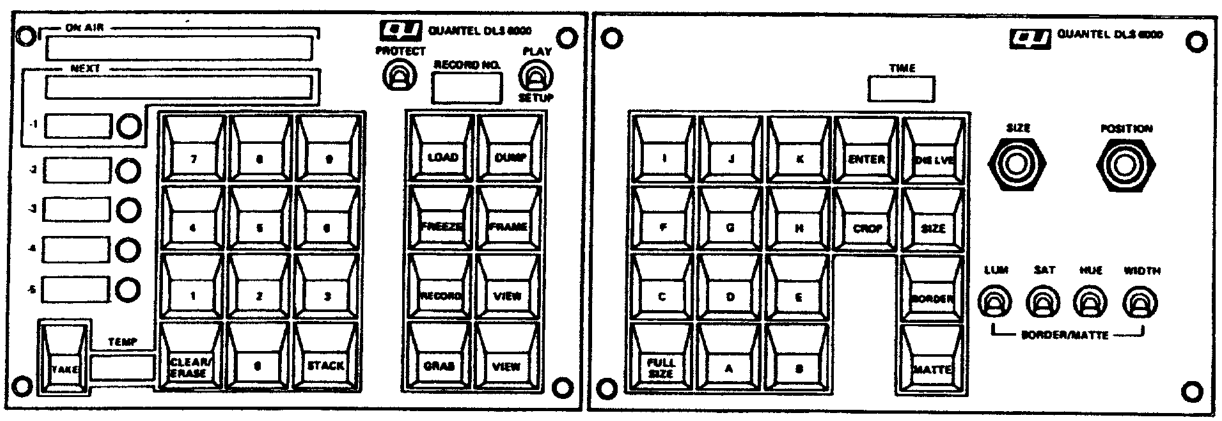


FIGURE 5. PRODUCTION EFFECTS PANEL

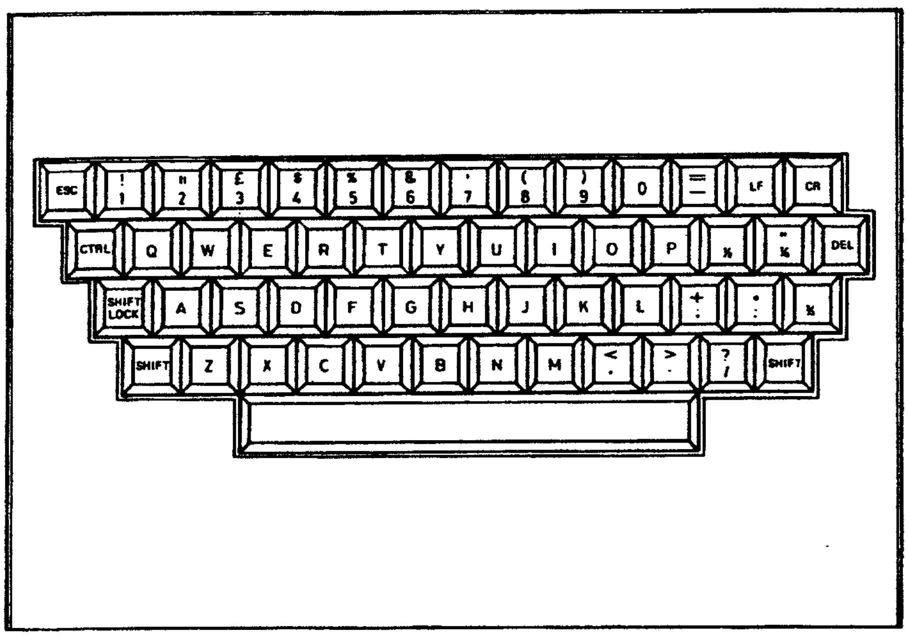


FIGURE 6. CONTROL KEYBOARD

L001376

AX022148

EXHIBIT 5

United States Patent [19] | [11] 4,302,776
Taylor et al. | [45] Nov. 24, 1981

[54] DIGITAL STILL PICTURE STORAGE SYSTEM WITH SIZE CHANGE FACILITY

[75] Inventors: Richard J. Taylor, London, England; Phillip P. Bennett, Foster City, Calif.

[73] Assignee: Micro Consultants Limited, Berkshire, England

[21] Appl. No.: 128,789

[22] Filed: Mar. 10, 1980

[30] Foreign Application Priority Data

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Nov. 9, 1979 [GB] United Kingdom 38847/79

[51] Int. Cl.³ H04N 5/76; H04N 5/92
[52] U.S. Cl. 358/160; 358/180; 358/138; 360/9; 360/33; 360/39

[58] Field of Search 358/160, 180, 133, 138; 360/33, 39, 8, 9

[56] References Cited

U.S. PATENT DOCUMENTS

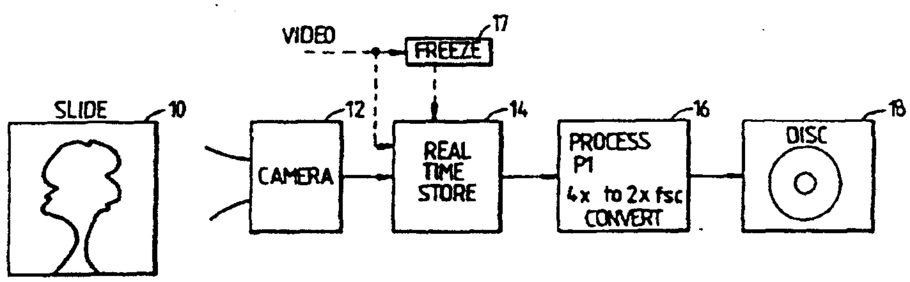
4,204,227 5/1980 Gurley 358/138

Primary Examiner—Robert L. Richardson
Attorney, Agent, or Firm—Dowell & Dowell

[57] ABSTRACT

A digital picture storage system with various facilities including size change. The system includes real time frame storage and a non-real time store expediently provided as disc storage. The size change mechanism has access to the data in the non-real time domain to allow size change techniques to be used which are more readily realizable.

34 Claims, 21 Drawing Figures



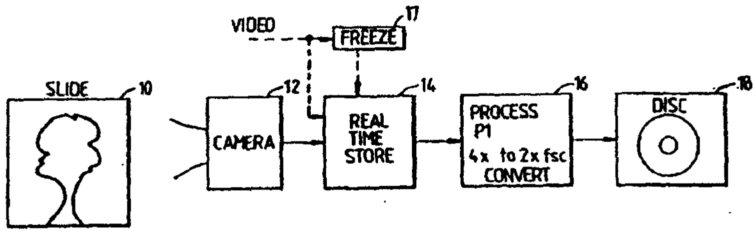

VIDEO
FREEZE
17
SLIDE
10
CAMERA
12
REAL TIME STORE
14
PROCESS P1 4x to 2x fsc CONVERT
16
DISC
18

Fig.1

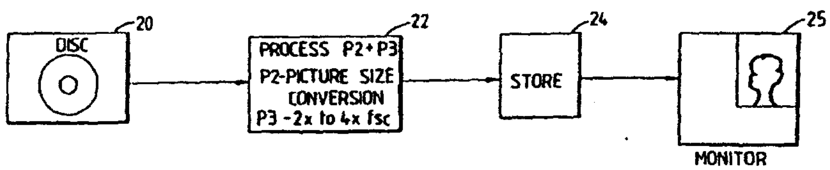
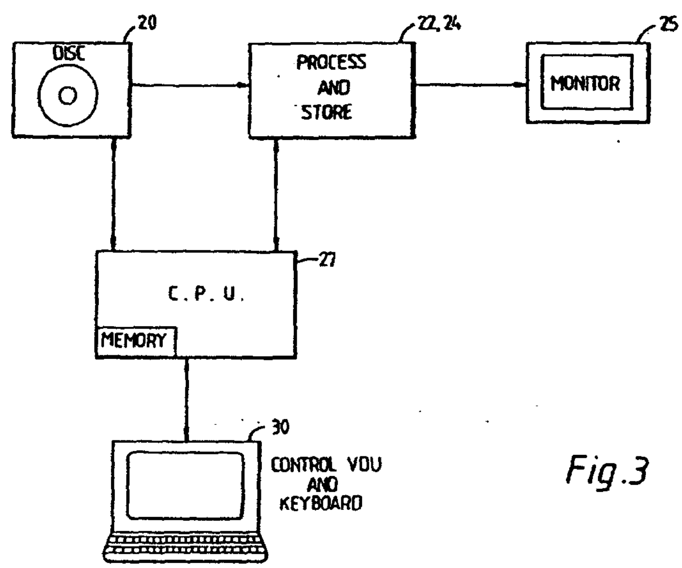

DISC
20
PROCESS P2+P3
P2-PICTURE SIZE CONVERSION
P3 -2x to 4x fsc
22
STORE
24
MONITOR
25

Fig.2



20
DISC
22, 24
PROCESS AND STORE
25
MONITOR
27
C.P.U.
MEMORY
30
CONTROL VDU AND KEYBOARD

Fig.3

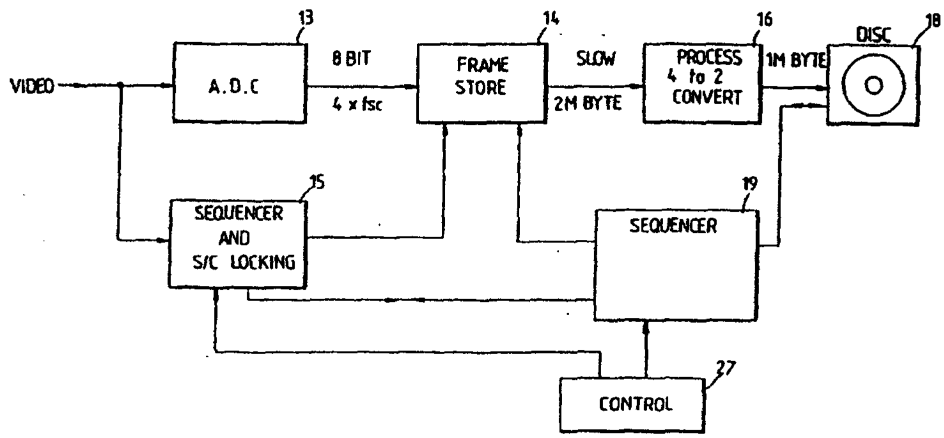

VIDEO
13
A.D.C
8 BIT
4 x fsc
14
FRAME STORE
SLOW
2M BYTE
16
PROCESS 4 to 2 CONVERT
1M BYTE
DISC
18
15
SEQUENCER AND S/C LOCKING
19
SEQUENCER
27
CONTROL

Fig.4

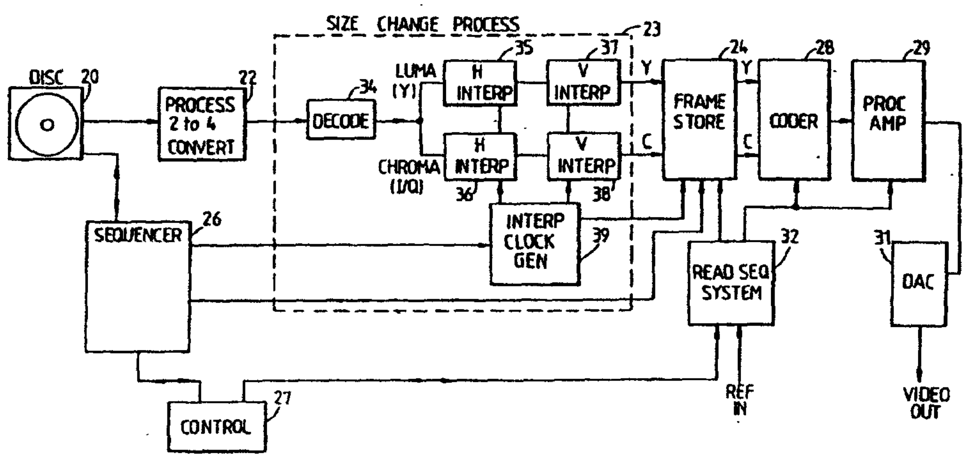
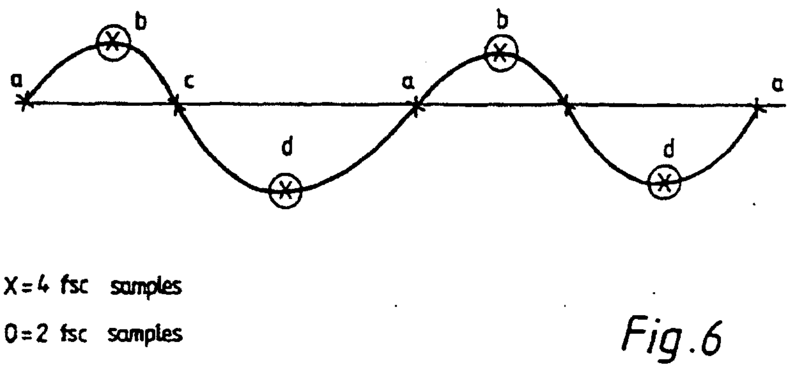
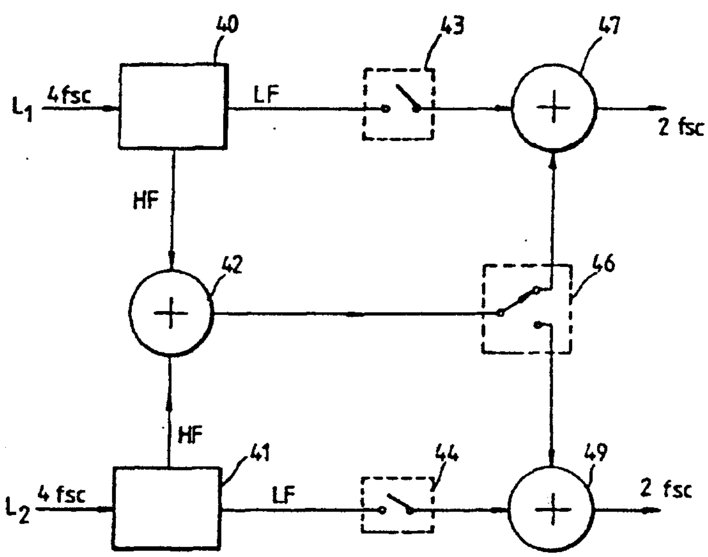

SIZE CHANGE PROCESS
23
DISC
20
PROCESS 2 to 4 CONVERT
22
DECODE
34
LUMA (Y)
CHROMA (I/Q)
H INTERP
35
H INTERP
36
V INTERP
37
V INTERP
38
INTERP CLOCK GEN
39
Y
C
FRAME STORE
24
CODER
28
PROC AMP
29
SEQUENCER
26
READ SEQ SYSTEM
32
DAC
31
VIDEO OUT
REF IN
CONTROL
27

Fig.5



a
b
c
a
b
a
d
d
X=4 fsc samples
O=2 fsc samples

Fig.6



40
43
47
L_1 4fsc
LF
2 fsc
HF
42
46
HF
41
44
49
L_2 4 fsc
LF
2 fsc

Fig.7

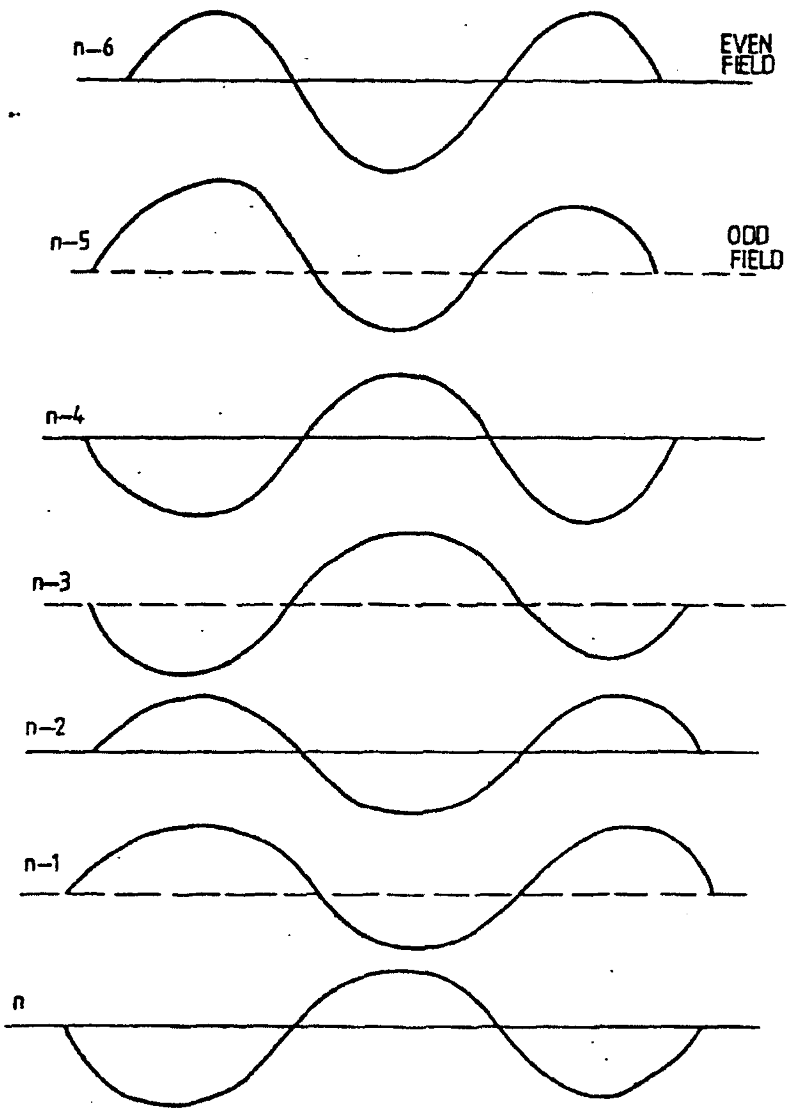
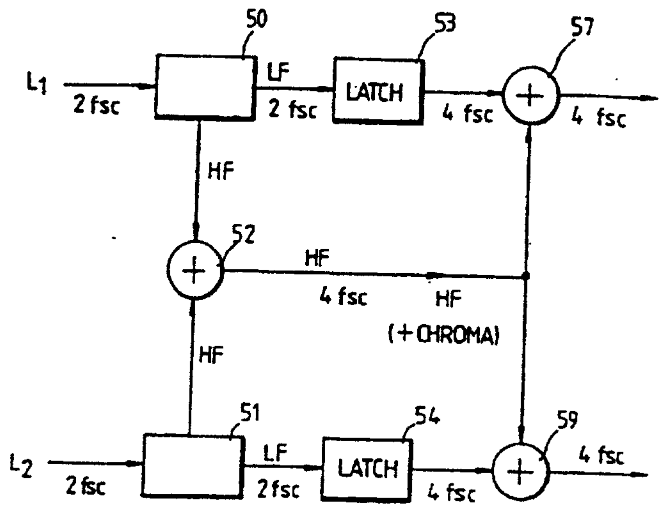


Fig.8



50
53
57
L_1
2 fsc
LF
2 fsc
LATCH
4 fsc
4 fsc
HF
52
HF
4 fsc
HF
(+CHROMA)
HF
51
54
59
L_2
2 fsc
LF
2 fsc
LATCH
4 fsc
4 fsc

Fig. 9

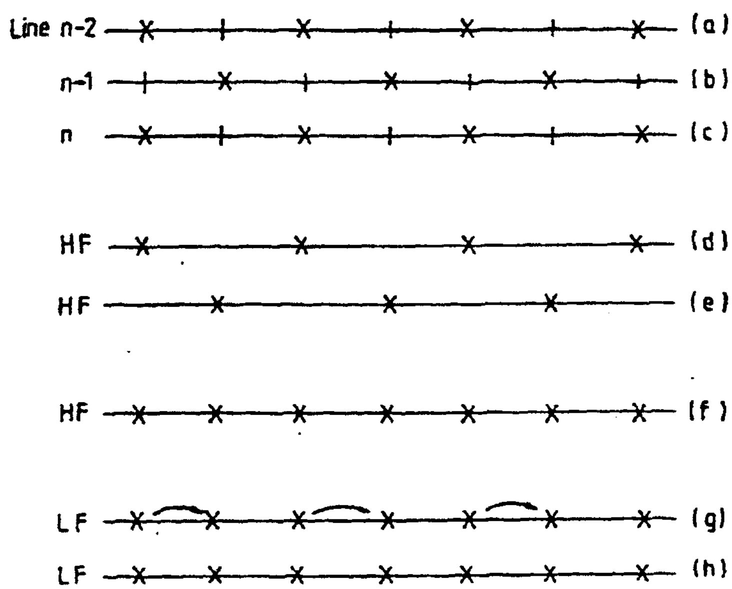


Fig. 10

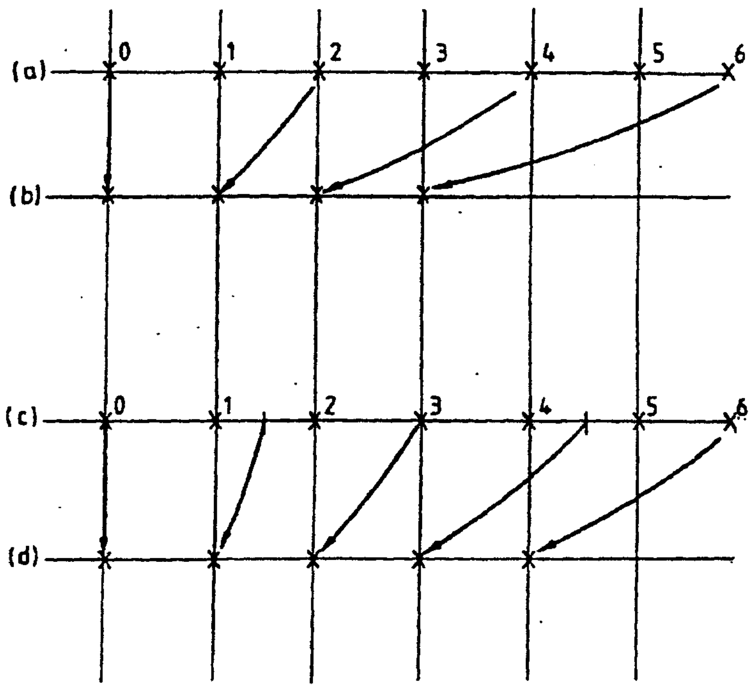
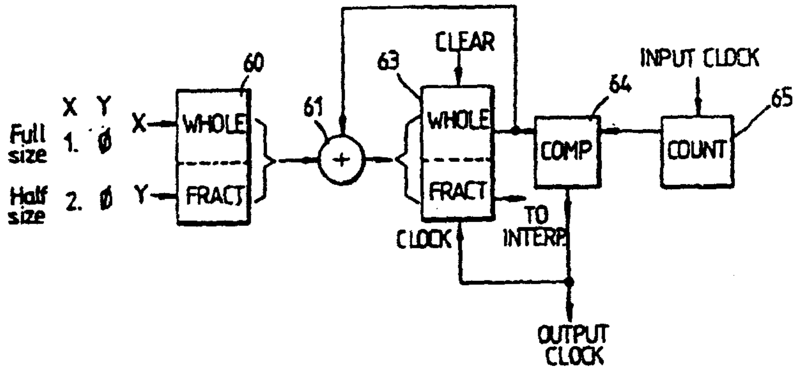
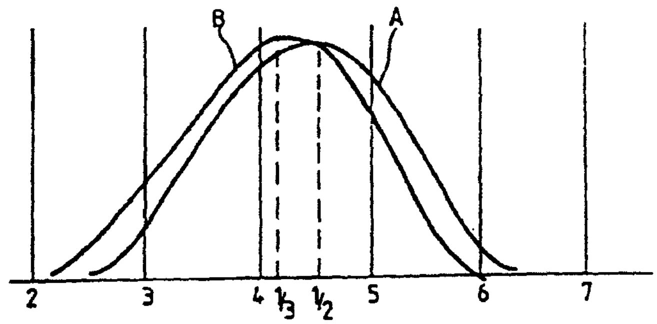


Fig. 11



60
63
CLEAR
INPUT CLOCK
64
65
61
X Y
Full size 1. Ø
Half size 2. Ø
X
Y
WHOLE
FRACT
WHOLE
FRACT
COMP
COUNT
CLOCK
TO INTERP
OUTPUT CLOCK

Fig. 12



B
A
2
3
4
1/3
1/2
5
6
7

Fig. 13

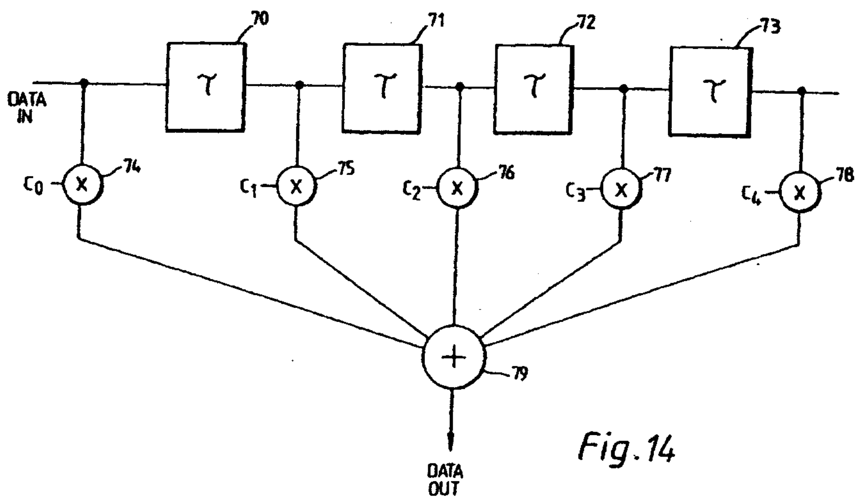
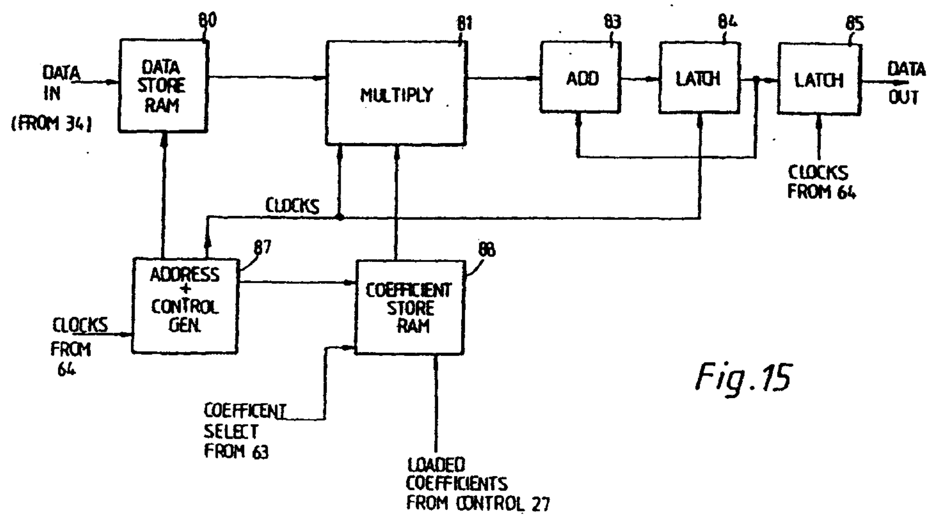


Fig. 14



80
81
83
84
85
DATA IN
(FROM 34)
DATA STORE RAM
MULTIPLY
ADD
LATCH
LATCH
DATA OUT
CLOCKS FROM 64
CLOCKS
87
88
ADDRESS + CONTROL GEN.
COEFFICIENT STORE RAM
CLOCKS FROM 64
COEFFICENT SELECT FROM 63
LOADED COEFFICIENTS FROM CONTROL 27

Fig. 15

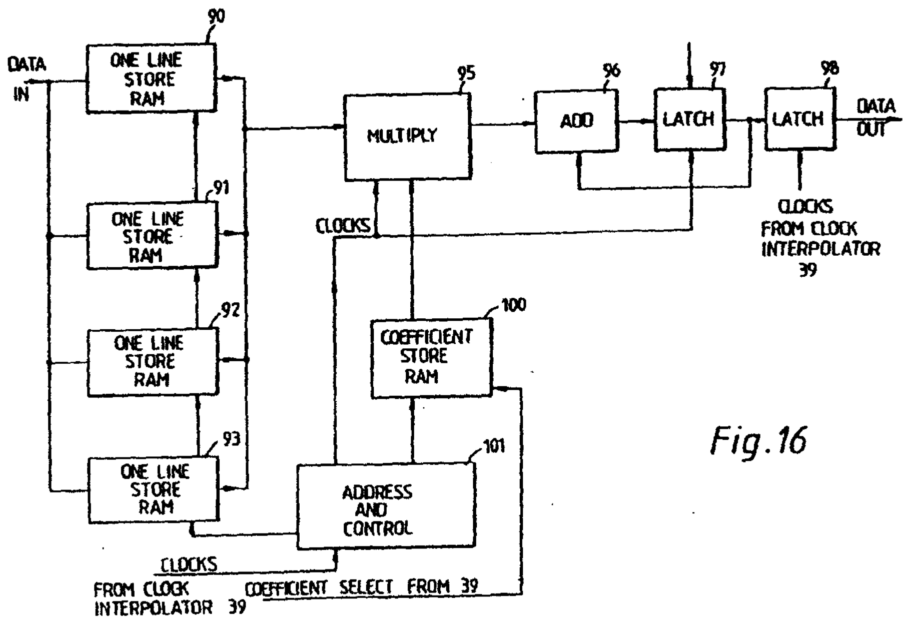

DATA IN
ONE LINE STORE RAM
90
ONE LINE STORE RAM
91
ONE LINE STORE RAM
92
ONE LINE STORE RAM
93
MULTIPLY
95
ADD
96
LATCH
97
LATCH
98
DATA OUT
CLOCKS
CLOCKS FROM CLOCK INTERPOLATOR 39
COEFFICIENT STORE RAM
100
ADDRESS AND CONTROL
101
CLOCKS
FROM CLOCK INTERPOLATOR 39
COEFFICIENT SELECT FROM 39

Fig.16

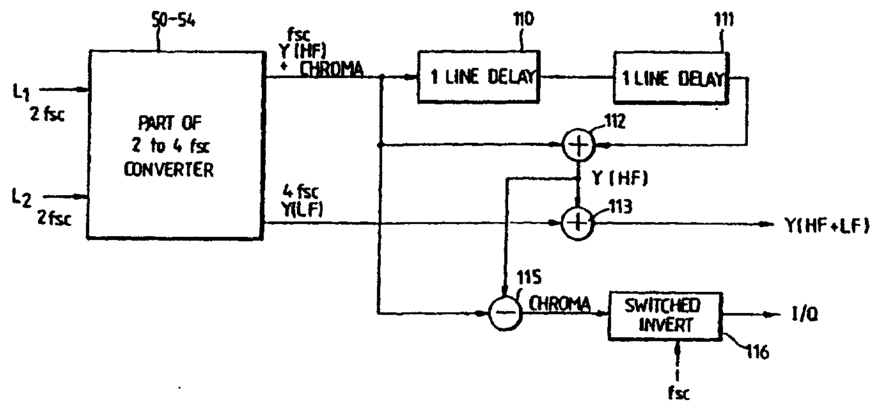
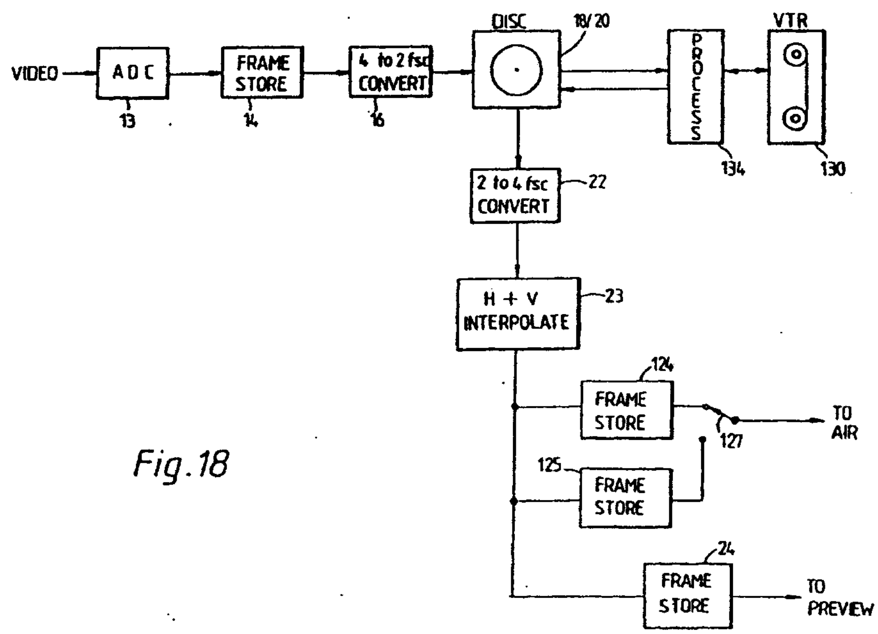

50-54
PART OF
2 to 4 fsc
CONVERTER
L_1
2 fsc
L_2
2fsc
fsc
Y (HF)
+ CHROMA
4 fsc
Y(LF)
110
1 LINE DELAY
111
1 LINE DELAY
112
Y (HF)
113
Y(HF+LF)
115
CHROMA
SWITCHED
INVERT
I/Q
116
fsc

Fig. 17



VIDEO
ADC
13
FRAME STORE
14
4 to 2 fsc CONVERT
16
DISC
18/20
PROCESS
134
VTR
130
2 to 4 fsc CONVERT
22
H + V INTERPOLATE
23
124
FRAME STORE
127
TO AIR
125
FRAME STORE
24
FRAME STORE
TO PREVIEW

Fig.18

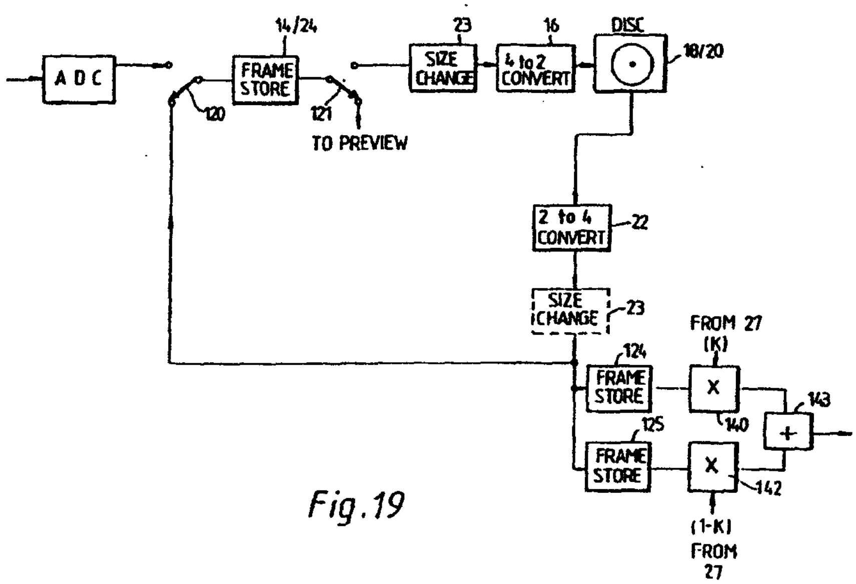

ADC
FRAME STORE
14/24
120
121
TO PREVIEW
SIZE CHANGE
23
4 to 2 CONVERT
16
DISC
18/20
2 to 4 CONVERT
22
SIZE CHANGE
23
FRAME STORE
124
FRAME STORE
125
FROM 27 (K)
X
140
X
142
(1-K) FROM 27
+
143

Fig.19

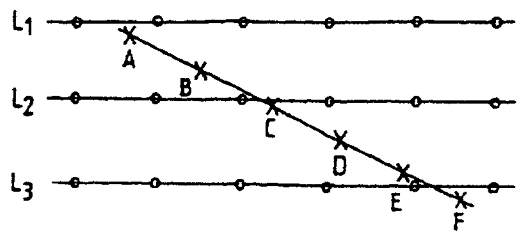

L1
L2
L3
A
B
C
D
E
F

Fig.20

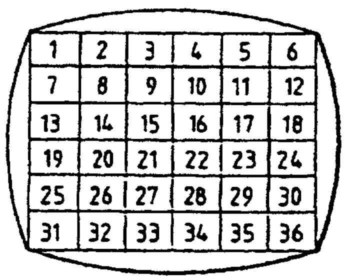

1 2 3 4 5 6
7 8 9 10 11 12
13 14 15 16 17 18
19 20 21 22 23 24
25 26 27 28 29 30
31 32 33 34 35 36

Fig.21.

DIGITAL STILL PICTURE STORAGE SYSTEM WITH SIZE CHANGE FACILITY

BACKGROUND TO THE INVENTION

The invention concerns digital still picture storage and also concerns aspects of digital picture processing suitable for use in a digital picture library system.

It is known to store still pictures (e.g. photographic slides) by using a television camera to convert the still photograph into a standard television format which is then stored on a suitable storage medium. Such an electronic still storage system is described in U.K. Patent Application No. 7,928,615 (35220/78) which uses a video tape recorder (VTR) to store the still picture frame and which frame is stored several times on the tape. On retrieval the storage system integrates the picture frame by frame to provide an output which appears undegraded regardless of shortcomings in the storage medium itself.

OBJECT OF THE INVENTION

The present invention is concerned with providing an improved storage system and/or digital processing suitable for use in such a storage system.

SUMMARY OF THE INVENTION

According to the invention there is provided a digital still picture storage system for storing a plurality of video frames comprising first digital frame storage means for capturing a frame of video information in digital form in real time, non-real time storage means for receiving and storing digital data captured by said frame storage means at a slower rate than that received by said frame storage means, and picture processor means for processing data in the non-real time domain for manipulating the size of the still picture when processed thereby relative to normal frame size.

The picture processing means may be provided prior to or following the non-real time storage means.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. 1 shows the basic record system,

FIG. 2 shows the basic playback system,

FIG. 3 shows the playback system under computer control,

FIG. 4 shows an embodiment of the basic record system in more detail,

FIG. 5 shows an embodiment of the basic playback system in more detail together with the facility for picture size change,

FIG. 6 shows the requirement for 4 fsc and 2 fsc sampling,

FIG. 7 shows one embodiment suitable for converting 4 fsc samples to 2 fsc,

FIG. 8 shows the subcarrier phase relationship between various picture lines,

FIG. 9 shows one embodiment suitable for converting samples from 2 fsc to 4 fsc,

FIG. 10 shows the various stages in such conversion,

FIG. 11 shows various components of picture size change in dependence on the size selected;

FIG. 12 shows in more detail the interpolating clock generator calculation function for retention of samples for size change,

FIG. 13 shows a graphical representation of portions of picture points used for the synthesis,

FIG. 14 shows the normal system used for dealing with the multiplication function;

FIG. 15 shows an embodiment of the present system using a single multiplier for horizontal interpolation;

FIG. 16 shows an embodiment used for vertical interpolation;

FIG. 17 shows an arrangement suitable for providing the decoder of FIG. 5;

FIG. 18 shows an expanded system with the facility for data transfer to an analogue VTR and using additional frame storage for rapid switching from one picture to another;

FIG. 19 shows an alternative configuration with modified facilities including fade-over;

FIG. 20 shows picture rotation achieved using manipulation of the interpolation coefficients; and

FIG. 21 shows the multiple display format for a number of reduced size pictures.

DESCRIPTION OF PREFERRED EMBODIMENTS

In the arrangement of FIG. 1 the recording system includes a camera 12 for receiving an image of slide 10. The camera output is received by real time store 14. The digital data for the store is received at 4 times subcarrier sampling rate (via a decoder and an ADC as necessary) from the camera. The data from store 14 is accessed by digital processor 16 in non-real time and this processor converts the 4× fsc sampling to 2× fsc. The processor output is received and stored on disc 18 for example which provides non-real time storage.

Thus, during the recording process in which data is entered to the still store from a video signal source, the digital storage takes place at two levels, namely the real time level in the solid state store 14 and the non-real time level in the disc store 18.

In the present embodiment, use has been made of a four-times colour sub-carrier sampling signal to effect the basic conversion from analogue into digital form and initial storage at the real time stage. This analogue to digital conversion is a standard technique, which is used in many digital television systems employing conversion and storage.

The contents of the real time store are transferred to disc where the capacity is limited and data compression desirable. In this system use is made of a process (described in more detail below) to convert from four times colour sub-carrier sampling to two times colour sub-carrier sampling in making the transfer between real time and non-real time.

The conversion system 16 has been designed so that it operates in the non-real time area, which allows considerable simplification of circuitry as very high speed operation is no longer required. At the same time, the digital filter function may be more easily implemented to its optimum characteristic.

Whilst the conversion process between four times and two times colour sub-carrier sampling is in effect a digital filter function, and types of digital filtering are known, the provision of a conversion process in a non-real time circuit rather than the known real time arrangements, its construction and application to an electronic still store or digital library system, is believed novel and in addition because of its non-real time operation it is constructed more simply yet can work at an optimum, as is its use of spacially adjacent lines.

A major enhancement has also been made to the system during the replay operation as shown in FIG. 2. The output from disc 20 is received by non-real time processor 22 which converts the data from 2 fsc to 4 fsc prior to receipt by real time store 24. The system is also capable of manipulating the data to provide picture reduction or enlargement as described below. The store data is read out at normal rate for displaying on a monitor 25 for example having first been converted into analogue form in a DAC and encoded as necessary.

Thus, during this replay mode, data is transferred from the disc into the real time solid state store through a processing path. The function of the processing path is to provide a conversion from two times to four times colour sub-carrier coding-being the inverse of the function described above-so that the real time store contains the same type of coded data originally entered. In this system, the processing path is again placed in the non-real time area, so that the filter function required can be implemented using slower speed and lower power consumption electronics.

An additional improvement and feature is concerned with the use of the non-time replay processor to create images which are expanded or reduced in size compared with the original stored picture on disc. The relative position within the normal frame can also be varied. This is in effect an electronic non-real time zoom system to allow pictures to be inserted into programmes such as news broadcasts via suitable switching. The system resembles the capabilities of an electronic slide scanner with a zoom lens. However, in the digital library system, it is possible to re-store the picture size in a compressed or enlarged form suitable for use in a sequence. Picture scroll can also be provided by manipulating the picture point addressing.

FIGS. 1 and 2 can be formed from a combined system where this shares the disc and real time stores when available or alternatively may be separate systems.

The contents of the disc store may hold several hundred separate pictures and the problem of examining the contents of the store in order to find a picture you need exists. It has already been described in the aforementioned patent application No. 35220/78 to include identification data to identify a particular picture held in storage. In the expanded arrangement of FIG. 3, the system is under control of computer 27 in dependence on control data fed from video display and keyboard unit 30. Thus although control of the disc and processor 22 and store 24 could be realised using hardware (see U.S. Pat. No. 4,183,058 for example) it is convenient to use software control to achieve greater flexibility (see U.S. Pat. No. 4,148,070, 4,163,249 and 4,172,264 for example). One facility effected by this present arrangement is the facility to provide a matrix of miniature pictures displayed together on the screen. This 'browse facility' displays the contents of the store in a series of 'polyphoto' formats, whereupon up to a total of 64 miniature pictures are displayed at once on the CRT. It then becomes possible to look at 'pages' within the store.

A further feature which can be provided concerns the indexing mechanism.

In order to assemble a sequence of still pictures suitable for incorporation into a television programme, it is necessary to identify each of the photographs held within the library system by a number or code. The system can display the number superimposed on the shot by exercising a control function. By selecting a sequence of numbers, the user can put together his required sequence of pictures. In addition, however, by the provision of suitable software using standard techniques for example it is possible to cross-reference the contents of the store by a series of classifications. Typically these could include sports personalities; politicians; actors; fires; football matches; races. Each shot is designated a code number which allows the reviewer to recall a complete page of items coming under any of the classifications above, so for example, he may see a page of sports personalities from which to choose his shots.

By further expansion of the system to allow a sequence of two separate still pictures to be assembled into two separate digital stores in real time, a digital process can then be provided which allows cross-fading to occur from one to the other stores. The digital process can be provided by multiplying one digital video signal by a constant and the second digital video signal by one minus the same constant (as described below with reference to FIG. 19).

Although the picture library recording system of FIG. 1 has been considered as storing still pictures themselves taken from still pictures (e.g. slides) the system can be adapted to capture moving pictures and store these for future use.

When making a still shot from a moving shot, such as taking one particular 'clip' from a video tape, it is necessary to 'stop motion' between fields if a satisfactory still is to be produced. One known method of undertaking this process involves a single field recording system in which a repeated field sequence is used to generate 'stop motion'. The disadvantage of this system is that the vertical resolution is seriously degraded. In the present library system, a method of 'stop motion' is expediently used for capturing moving pictures (when the incoming video is not from a slide for example) and is shown by the freeze control block 17 for store 14, whereby motion detectors within freeze control 17 select parts of the picture which have remained stationary and record them as a two field sequence at full vertical resolution but inhibit the mechanism during motion, so that only single field reproduction from store 14 is used. Such a picture freeze system is described in U.K. patent application No. 35988/78.

Although the selection of a desired picture actually displayed in the case of a picture matrix 'page' or as one of a list of titles has been described as selected via the keyboard, it would also be possible to select desired pictures by use of a light pen, for example.

The above system will now be described in more detail with reference to FIG. 4. Incoming video which may be from a still or moving picture (asynchronous to the system reference signals or not) is passed to analogue to digital converter (ADC) 13 if not already in digital form. The ADC output is typically in 8 bit form at a rate of 4× fsc and this data is written into the frame store 14 under the control of sequencer 15 using normal techniques. The read out of the captured frame from the store 14 (because of its asynchronous capability) can be at a slower data rate which is compatible with the rest of the system (typically 2 M Byte/sec). The data read out is processed by converter 16 which converts the data from 4 to 2× fsc so as to output data at a rate of 1 M Byte/sec. The converter 16 is primarily provided to reduce the amount of information made available to disc control 18 by exploiting the redundancy on the T.V. signal thus effectively increasing the packing density. The read out from store 14 and write in for disc 18 is

under the control of sequencer 19. Thus the system is capable of providing 4 to 2 times conversion at the read side of the store at the data rate compatible with the disc rather than the normal video data rate. Thus whereas typically a 14.3 M Hz data rate would be required before the store, only a 2 M Hz rate is required after the store.

Sequencer 19 can be formed to be under the control of the computer system 27 and 30 of FIG. 3.

The FIG. 5 arrangement shows an example of the FIG. 2 replay configuration together with processing to allow the picture size to be altered.

The picture data stored on disc unit 20 (which could alternatively be the drive unit 18) is output at the data rate compatible with the disc drive, typically 1 M Byte/sec. The processor 22 converts the data from 2 to 4×fsc to reconstitute the data to the form originally produced in the record system prior to processing. The data at a rate of 2 M Byte/sec is made available to size change processor 23 which can alter the size of the desired picture taking into account sequencing information from sequencer 26 as described in more detail below. Basically the video data is decoded into its digital luminance and chrominance components by decoder 34 and the luminance (Y) and chrominance (I/Q) are processed in separate horizontal interpolators 35, 36 and vertical interpolators 37, 38 under the control of interpolating clock generator 39. The interpolating clock generator 39 decides how big a picture size has been chosen and what samples (and their percentages from various samples) are required for a particular compression size, for example. By providing processor 23 in a position to receive data at the relatively slow rate provided from the disc it is possible to provide sophisticated digital processing throughout to achieve size change without degradation problems.

Sequencers 26 and 32 can be controlled for example by computer system 27 and 30 of FIG. 3.

The processed video data is received by frame store 24 which data is still in its separated components. The frame store allows the data to be input at the slower disc rate (typically 2 M Byte/sec) under the control of sequencer 26 and generator 46, and read out at the faster video rate (say 14.3 M Hz) under the control of a read sequencer 32 locked to standard reference signals. The sequencer also provides control inputs to a coder 28 which recodes the video data into composite format which passes to process amplifier 29 also under the control of sequencer 32. The output digital video is converted into analog form as desired by converter 31. By providing the coder 28 after the frame store the need for a chroma inverter is removed thus avoiding problems associated with chroma flicker. In the basic system the size change processing could be omitted so that the FIG. 5 arrangement would correspond more simply to the reverse of the FIG. 4 arrangement.

Although FIGS. 4 and 5 are shown as separate systems some elements including the frame store could be shared.

The converter mechanism of block 16 of FIG. 4 is now described with relation to FIGS. 3 and 7. The subcarrier waveform shown in FIG. 6 is shown with samples at points X a rate of 4 times per cycle (4 fsc). In order to reduce the sampling rate whilst maintaining the desired data, sampling at points 0 is shown which corresponds to a rate of 2 fsc. Had the reduced number of sampling points been chosen along the axis then the data

would have been invalid. This is only a problem with high frequency portions of the video data.

A system capable of providing the 2 to 4 fsc conversion is shown in FIG. 7. In practice converter 16 receives video data from two lines L_1 and L_2 to provide the conversion process. Because the picture data is stationary (captured by frame store 14 if moving) the lines need not be from the same field as explained with reference to FIG. 8. Lines n-6 to n represent consecutive lines on a frame of video information, the solid and broken lines representing even and odd fields respectively. Due to the phase relationship of the analogue signals it can be seen for example that lines n-4 and n-3 are compatible but only if the picture is not moving otherwise movement errors due to changes in the fields may occur. Thus in prior arrangements where attempts have been made to use information from two lines it has been necessary to use lines n-4 and n for example as these are the two closest lines of correct phase relationship from the same field, to avoid any picture degradation due to movement. In the present system, due to the stationary image, use can be made of adjacent lines n-4 and n-3 and by providing the processor with reduced data rate (as determined by the read out rate from the store 14 of FIG. 4) a suitable converter can be realised.

Returning to FIG. 7, taking L_1 as the line which is to be coded from 4 to 2 fsc then information from line L_2 is also used, this line being below L_1 when processing a line from the first field and from above when coding a line from the alternate field.

The data for L_1 is received by filter 40 which separates the video into high and low frequency data. The high frequency data at 4 fsc passes to adder 42 which also receives high frequency data from filter 41 relating to L_2. The low frequency data at 4 fsc from the respective filters 40 and 41 pass via switches 43 and 44 to adders 47 or 49. These switches are arranged to close so as to only pass on every other sample to the adders. Thus samples a, b, c, d, for lines L_1 and L_2 will pass from filters 40 but due to switch 43 will reduce to samples b, d, and from filter 41 due to switch 44 will pass only a, c. Thus the data rate is reduced to 2 fsc. Adder 42 will produce the average of the high frequency data from the two lines and the 4 fsc rate will effectively be reduced by switch 46 which alternates between adders 47 and 49 such that samples b, d, b, d will pass to adder 47 and a,c,a,c, to adder 48. Thus the averaged high frequency data is added to the low frequency data and available at 2 fsc from the output of adder 47 (or 49).

An arrangement for the processor 22 used on the replay system of FIG. 5 is shown in FIG. 9. Data at 2 fsc is applied to filters 50 and 51 respectively for lines L_1 and L_2. The low frequency data is received by latches 53 and 54 respectively and the high frequency data is received by adder 52 which merges these samples for the two lines. As each of these will contain different samples at 2 fsc, when merged the result will be samples at a rate of 4 fsc. The latches 53 and 54 effectively hold the data to enable the samples to be repeated so that again data to adders 57 and 59 are provided at 4 fsc. Each of the latches could be replaced by using a low pass filter each having a delay in the increment on one ½ sample. In any event adder 57 adds the high and low frequency data to produce the 4 fsc video data stream for receipt by the converter 23 or possibly directly by the store 24 of FIG. 5.

The way in which the samples are effectively manipulated through the conversion is represented by the

FIG. 10 diagram. FIG. 10(*a*), (*b*) and (*c*) represent the samples along respective lines. Samples represented as X are retained and samples represented as ÷ are lost in the 4 to 2 fsc conversion of FIG. 7. The HF sample data at 2 fsc, see (*d*) and (*e*) separated by filters 50 and 51 of FIG. 9 are combined in adder 52 to provide the HF sample data (see (*f*)) at 4 fsc. The LF sample data separated by filter 50 (say) is held by latch 53 so as to repeat (see (*g*)), thus providing 4 fsc samples as shown in (*h*).

The picture size processor 23 of FIG. 5 will now be described in more detail. As already explained, the video data is decoded into luminance and chrominance components by means of decoder 34 and passes to horizontal interpolators 35 and 36 and vertical interpolators 37 and 38 respectively. The interpolators comprise low pass filters which filter the incoming digital data to prevent violation of the sampling laws at reduced picture sizes. Additionally they can produce synthetic samples in between the original input points by producing filtering with non-integer group delays. The operation of the interpolators is controlled by the interpolating clock generator 39 which ties together the input sampling with the desired number of samples required to constitute the reduced size picture (i.e. to produce the desired ratio between them to track with a required picture size). Thus looking at the representation in FIG. 11 the number of samples along a particular line will be fixed for the incoming (uncompressed) picture as respective picture points. For a compressed picture the number of picture points required to be output will be less. Taking the situation where a half size picture is required then ½ the number of samples in 11(*a*) can be used to constitute the desired samples of 11(*b*). This covers compression in the horizontal direction. Vertically the mechanism is similar. In the situation where rather than 2:1 compression is required a reduction of say 1.5:1 is chosen then the requirement is not merely to select a sample but to interpolate samples nearest to a desired position, if a degraded picture is to be avoided.

This can be represented by 11(*c*) and 11(*d*) which respectively show incoming samples and outgoing samples. In the basic situation, the outgoing samples can be synthesised by data from the two 'nearest' original samples, the percentages of each sample being chosen in dependence on how near those samples are to the desired output sample position. Again only the horizontal compression is considered. In practice however, it has been found that rather than using just picture point data from the nearest picture point on either side use can be made of data from several picture points on either side, the percentage of the data actually used from each picture being less the further the picture points are away from the proposed position.

A way in which the interpolating clock generator can control this synthesis is now described with relation to FIG. 12. Compression data is made available from control 27 of FIG. 5. A latch 60 receives data X and Y indicative of the desired degree of compression, via sequencer 26 of FIG. 5. Thus for a full size picture X=1 and Y=0; for a half size picture X=2 and Y=0 and so on. The upper half of the latch receives whole sample data (i.e. 1, 2 etc) and the lower half the fractional sample data as explained in more detail below.

The latch output is received by adder 61 which has as its second input the output of a further latch 63. This latch 63 receives the adder output and is cleared at the start of each line and receives clocks derived from the output of comparator 64. Comparator 64 compares the output of counter 65 with the output of latch 63. Counter 65 counts how many picture points have occurred and this denotes which picture point is present at any time and comparator 64 decides whether this picture point is required for interpolation as now explained. In the situation where a full size picture is required then latch 60 is set to 1.0 at the start of the line and latch 63 and counter 65 are cleared. During the first computation cycle at picture point 0 we have 0 into both sides of the comparator thus producing a high (1) output denoting a wanted sample. At this time latch 63 is clocked. At this point the inputs to adder 61 comprise 1.0 from latch 60 and zero from latch 63 thus the output from adder 61 comprises 1.0 which is entered into latch 63. During the next computation for the second picture point, at picture point 1 there will be 1.0 on either side of comparator 64 and thus a true (1) output therefore indicative that this picture point is required. At the same time latch 63 is clocked and an input of 2.0 is entered from adder 61 (made up of 1.0 from latch 60 and 1.0 from latch 63). This process is repeated for each input sample. When half size picture is required then latch input is set as 2.0 and at the start of the line latch 63 and counter 65 are cleared. At picture point 0 there is 0 on both sides of comparator and this gives a true out and latch 63 is clocked. At this point the input to adder 61 is 2.0 from latch 60 and 0.0 from the output of latch 63. Thus latch 63 once clocked contains 2.0. An output sample is generated in this cycle due to the comparator output.

During the next cycle at picture point 1 there is 2.0 from latch 63 present at one side of comparator 64 and 1 at the counter side. Thus comparator produces a false (0) output and therefore latch 63 is not clocked nor is an output sample generated.

In the third cycle, at picture point 2 then there is 2.0 present on both sides of comparator 64 and thus a true is produced clocking latch 63 and indicating that this sample is required. The input to latch 63 from adder 61 comprises 4.0 made up of 2.0 from latch 60 and 2.0 from the output of latch 63. This process repeats. At this time the interpolating filter (of FIG. 5) will have coefficients fed to it to produce a cut-off frequency of ½ the maximum in that direction.

When a size intermediate between ½ and full size is required then the fractional output portion of latch 63 comes into play as now explained. If we select a size such that the input to latch 60 comprises 1.5 i.e. $1+(1\times\frac{1}{2})$ then at the start of the line with latch 63 and counter 65 cleared, then at picture point 0 there is a zero at both sides of comparator 64 and a true output is produced clocking latch 63 and indicating that this sample is required. The input to latch 63 on clocking comprises 1.5 made up of 1.5 from latch 60 and 0.0 from latch 63.

In the second cycle at picture point 1 there will be at the input of comparator 64 a 1.0 from latch 63 (only the whole part is pertinent) and 1 from the counter 65. Thus comparator 64 gives a true out, therefore an output sample is generated and latch 63 is clocked with the output from adder 61 which is 3.0 made up of 1.5 from latch 60 and 1.5 from latch 63. The remainder (i.e. ½) from latch 63 is used in the interpolating filters of FIG. 5. The ½ effectively defines the position of the picture point to be synthesised relative the original picture points (in this case half way between picture points 1 and 2).

The interpolating clock generator of FIG. 12 is effectively duplicated to provide the entire clock system for

both horizontal and vertical interpolation. Taking FIG. 12 as the horizontal interpolating clock generator, the counter 65 is clocked once per picture point. In the vertical generator, the operation will be at line rate, rather than picture point rate and the output clock will be used to gate the vertical interpolators on a line by line basis rather than on a picture point basis.

In practice a picture point is synthesised from more than one original picture point on either side and may use for example portions from up to 8 picture points. The curve A of FIG. 13 represents the typical proportion of adjacent picture points used. Different portions in dependence on the calculated remainder may be used (as represented by curve B for when the remainder is ½). These percentages may be stored in a look up table (using a ROM or RAM for example) accessed in dependence on the calculated remainder. The portions of each picture point could be provided by using a number of digital multipliers each receiving a specific coefficient read out, the multiplier outputs being received by an adder to provide the synthetic picture point at its output as described in U.S. Pat. No. 4,163,249, and as now shown in the system of FIG. 14. Incoming picture point data passes via picture point delays 70-73 and each of the digital multipliers 74-78 is arranged to receive one of the five sequentially required picture point samples for multiplication by a selected coefficient C_0 and C_4 respectively. Although 5 picture points are shown as being processed, the number of multipliers and delays could be expanded to handle 8 picture points for example.

The multiplier outputs are received by adder 79 to give the processed output. In practice due to the relatively slow data rate (due to positioning the size change processing prior to the frame store 24 of FIG. 5) it is expedient to modify this known technique as now explained with regard to FIG. 15, so as to use a single multiplier multiplexed to handle the sequential data samples. Thus FIG. 15 shows a system suitable for one of the horizontal interpolators 35 or 36 of FIG. 5.

Data is received at the input to data store RAM 80 and desired samples are held by this store under the control of address and control generator 87 which itself receives clock pulses from the interpolating clock generator 39 of FIG. 5 (and more specifically from block 64 of FIG. 12). The data store 80 effectively holds a stack of data each from a picture point sample. This stack (say 8 samples) is sequentially made available under the address control 87 to the input of multiplier 81 where it is multiplied by a desired coefficient provided by coefficient store 88. The coefficient RAM will previously have been loaded by sets of coefficients from the computer control 27. These sets give a different group delay according to the remainder determined by the remainder calculated by the interpolating clock generator along the lines represented by FIG. 13, showing two possible curves. The coefficient selected in dependence on the output of latch 63 (of FIG. 12) used by the multiplier for that particular picture point. The multiplier output is accumulated with the previous multiplied data by means of adder 83 and latch 84. Because of the relatively slow data rate it is possible to accumulate and sum all the portions in the period between single input samples. Thus each data clock received by control 87 will cause the incoming sample to be entered into the data stack within RAM 80. Between clocks the data within store 80 is successively multiplied and accumulated 8 times, latch 84 being cleared to zero prior to the accumulation and clocked after each multiply (and add) step, under the control of generator 87.

The output available from latch 84 is selectively held by latch 85 under the control of a clock from interpolation generator 39. Thus dependent on the output from comparator 64 of FIG. 12 then if the sample synthesised is required then latch 85 is clocked and holds this sample for further use.

To produce the vertical interpolators 37 and 38 of FIG. 5 a similar approach is adopted as shown in FIG. 16 except that one line stores are used rather than the requirement for storing single picture points. (Two such arrangements will be required to provide both interpolators 37 and 38.) Although only 4 one line stores 90-93 are shown these typically would be expanded to a capability of 8 lines of storage. The data for each of the lines is entered into the RAMS 90-93 under the control of block 101 and the desired samples (one from each line) are made available under this control to multiplier 95 which as before multiplies each sample by a coefficient held in coefficient store RAM 100 (previously entered via computer control 27 of FIG. 5). The multiplier is multiplexed to handle the samples and the successive processed samples are accumulated by adder 96 and latch 97. Any desired synthesised samples are held by latch 98 under the control of the clock from generator 39 as before. Thus each of the samples taken from a particular location along respective T.V. lines are multiplied and summed to produce a first synthesised sample. The next sample is synthesised by samples taken from the next location along the same T.V. lines, and so on. Each complete multiplication process is effected during the period between incoming samples, which samples will comprise incoming data from one of the lines to be processed. The line stores, as before, form a data stack which effectively is switched so that it is updated line by line, the earliest line in time being lost and replaced by current data.

The percentages of the picture points are determined in proportion to the calculated remainders in a similar way to the curves of FIG. 13 by interpolator 39.

Returning to FIG. 5, an arrangement suitable for the decoder 34 therein will now be described in more detail. As already explained in relation to FIG. 9, the 2 to 4 fsc converter can be realised using blocks 50-59. In practice, due to the processing steps carried out in the FIG. 6 arrangement, a decoder can be realised which makes use of some of these earlier steps as now described with reference to FIG. 17, so as to provide a combined converter and decoder.

Parts of the existing converter utilised (blocks 50-54 of FIG. 9) are shown on the left hand side of the present figure and two outputs are shown comprising luminance HF (+chroma) from adder 52 and luminance LF from latch 53. Two one line delays 110 and 111 are required so as to provide a delay corresponding to 1 line in the same field (e.g. if the output of delay 111 is line n-6 and the input to the first delay 110 is n-4, see FIG. 8). The current and delayed data is added in adder 112 so that effectively the chrominance component is cancelled, therefore the output from the adder is merely Y(HF). This output is added to the Y(LF) from the converter by means of adder 113 so as to provide reconstituted luminance (with LF and HF). The output from adder 112 is also received by subtractor 115 which provides chrominance only at its output.

This chrominance data is received by inverter 116 to switch chrominance (at fsc) so as to provide alternating

chrominance sample by sample. Although chrominance and luminance separation using digital comb filtering is known, the present system employed in conjunction with, and following, the 2 to 4 fsc converter is believed novel. The output of adder 113 comprising the luminance data is passed to interpolator block 35 of FIG. 5 and the chrominance from inverter 116 is passed to interpolator block 36.

The basic system can be expanded as shown in FIG. 18 to incorporate additional facilities. In addition to the combined system of FIGS. 4 and 5, an analogue VTR 130 is provided to allow transfer of digital data from the disc 18/20. The data from converter 16 for disc 18/20 is put into the correct digital format and the data read out from the disc for receipt by VTR 130 is formatted as required. The data passes to the VTR via processor 134 which processes the data including inserting analog sync information to allow storage of the digital data on the analogue machine and removes the sync information on playback to provide correctly formatted digital data once again as described in more detail in copending British Patent Application No. 7,930,222.

The output of interpolator 23 can be received by a number of frame stores 124, 125 for example and under the control of switch 127 a particular picture can be selected 'on air' to provide a choice of picture material. Switch 127 can be integral with the system or externally provided.

The store 24 can be used as a preview store to be used independently of the other stores 124 and 125 to provide a preview facility for example. This facility could alternatively be provided by using store 14 when available. The number of stores used could be expanded as required.

In the alternative arrangement of FIG. 19 the frame stores 14 and 24 of FIG. 18 are shown as comprising a single store switchable under the control of switches 120 and 121 (typically solid state switching) to reduce the requirement for two stores for this function. It would also be possible to provide size change prior to converter 16 as now shown in FIG. 19 by moving the position of processor 23 to provide an increase or decrease in picture size relative to normal frame size prior to storage on disc 18 should this be desired. Further with suitable switching it would be possible to share the size change facility between input and output of the disc 18.

The stores 124 and 125 have outputs now received by multipliers 140 and 142 respectively with the multiplier outputs received by adder 143 to provide an output (replacing that provided at switch 127 output of FIG. 18). The multipliers 140 and 142 provide a fade-over facility by varying the portion of picture used from the respective stores as mentioned above concerning FIG. 3. In practice the picture output is determined by selecting a value of K (or 1-K) typically made available from control 27. The value of K is gradually increased from zero to 1 and thus (1-K) reduces from 1 to zero. When K=0 then no portion of the output of store 124 is provided at the output of adder 143 and thus the output entirely comprises the output from store 125. Thus the output system would simply act as a switch. However as K is gradually increased then the portion of the picture from store 124 is increased gradually replacing that provided from store 125.

In situations where the fade-over facility is not required it is possible by selecting K to be only zero or 1 to have a simple switching action between stores 124 and 125. The interpolation provided by block 23 has been described so far as providing a linear size change across the entire picture. In practice it is possible to vary the interpolation to provide various visual effects. In addition to normal size increase or reduction, an increasing size change of a picture frame by frame will provide a picture zoom up facility, and using the reverse technique picture zoom down is provided.

By varying the horizontal and vertical size line by line, it is possible to create a different shape picture (i.e. non-rectangular) as described in more detail in British Patent Application No. 11361/77.

By combining appropriate combinations of horizontal and vertical coefficients in the interpolators, it is possible to rotate the picture which is an important feature when used with captions as for example a horizontal misalignment can be compensated by effectively rotating the caption. This is shown in FIG. 20. Actual picture point samples for lines 1, 2 and 3 are shown and the synthesised samples A, B, C, D, E and F are chosen to form the horizontal line when read out. Such a line will be seen to have been effectively rotated.

It is possible to use a fixed degree of compression to generate a frame comprising a number of stored pictures to provide a browse or polyphoto facility as shown in FIG. 21. The pictures comprise a number of successive compressed images (e.g. 16, 25 or 36 say, as in this example) which are available for display together based on the technique already described in British Patent Application No. 7,910,113.

The pictures displayed may follow the order actually stored on the disc or alternatively can be in the order actually accessed. The picture can be made to scroll horizontally or vertically as sequential pictures are compressed to provide visual access to the entire library of pictures stored. (See also U.S. Pat. No. 4,148,070).

The multiple display of pictures is made by writing more than one compressed picture from the disc into the frame store 26. This compression can be achieved during actual disc time or alternatively achieved during compiling the library and then recorded as a new frame back onto the disc.

It is to be appreciated that the system described would be suitable for NTSC (or for PAL or SECAM) modified as required to handle that type of T.V. format.

Although the system has been described generally in relation to providing a storage system with a large number of facilities such as size change or data quantity reduction the system could be simplified to include just one of these facilities.

We claim:

1. A digital still picture storage system for storing a plurality of video frames comprising first digital frame storage means adapted to capture a frame of video information in digital form in real time, non-real time storage means adapted to receive and store digital data captured by said frame storage means at a slower rate than that received by said frame storage means, and picture processor means adapted to process data in the non-real time domain so as to manipulate the size of the still picture when processed thereby relative to normal frame size.

2. A system according to claim 1, including second digital frame storage means for receiving data output from said non-real time storage means and adapted to allow the data from said storage system to be made available at normal video data rates.

3. A system according to claim 2, wherein the first and second frame storage means are provided as a common frame store and including means cooperating therewith adapted to effect switching between the input and the output of the non-real time storage means.

4. A system according to claim 2, wherein additional digital frame storage means are provided adapted to selectively receive the data from said non-real time storage means to provide a number of still picture frames simultaneously for output from the storage system.

5. A system according to claim 1 including data transfer means adapted to transfer the digital data corresponding to a plurality of still pictures held in said non-real time storage means for retention by retaining means.

6. A system according to claim 5, wherein the retaining means comprises an analogue video tape recorder and said transfer means comprises a signal processor adapted to insert analogue sync information with the digital data to allow the digital data to be retained by the analogue tape recorder.

7. A system according to claim 1, wherein the digital frame storage means comprises a solid state memory and said non-real time storage means comprises a digital disc store.

8. A system according to claim 1, wherein decoder means are provided prior to said picture processing means and adapted to separate the data into chrominance and luminance components before processing.

9. A system according to claim 8, wherein the decoder means comprises a digital comb filter.

10. A system according to claim 1, wherein the picture processing means includes a horizontal interpolator for synthesising each desired picture point from data on adjacent picture point samples along an adjacent line and a vertical interpolator for synthesising each desired picture point from data on adjacent picture samples along adjacent lines and control means adapted to determine the degree of interpolation between the picture point data in dependence on the picture size selected.

11. A system according to claim 10, wherein the horizontal interpolator includes input picture point storage means adapted to receive and store data from a plurality of adjacent picture points, multiplier means adapted to sequentially multiply the data on each of the stored picture points by a selected and variable coefficient, adder means adapted to sequentially add the output of said multiplier for each multiplying step to provide an accumulated output therefrom.

12. A system according to claim 11, wherein holding means are provided between the input and the output of said adder means and adapted to hold the data from the previous addition step for addition to the multiplier means output in the accumulation process.

13. A system according to claim 11, wherein coefficient storage means are provided adapted to store a plurality of coefficients for output to said multiplier means in dependence on the control means.

14. A system according to claim 11, wherein the vertical interpolator includes input line storage means adapted to receive and store data from a plurality of picture points from several lines, multiplier means adapted to sequentially multiply the data on picture points each from an adjacent stored line by a selected and variable coefficient, and adder means adapted to sequentially add the output of said multiplier for each multiplying step to provide an accumulated output therefrom.

15. A system according to claim 14, wherein holding means are provided between the input and output of said adder means and adapted to hold the data from the previous addition step for addition to the multiplier means output in the accumulation process.

16. A system according to claim 14, wherein coefficient storage means are provided adapted to store a plurality of coefficients for output to said multiplier means in dependence on the control means.

17. A system according to claim 10, wherein the control means comprises input means adapted to receive and hold data indicative of a desired picture size, first computation means adapted to calculate whether data on an incoming picture point available to said interpolators is required for use in the picture synthesis for that selected picture size, and second computation means adapted to determine the required coefficient for use by the multiplier of said interpolator for the selected picture point data.

18. A system according to claim 17, wherein the first and second computation means comprise an adder for receiving the data indicative of a desired picture size, a memory for holding the adder output, the memory output being available for addition to the picture size data in said adder, a comparator for comparing the held adder output with data indicative of the frame position of the picture data then available for receipt by the interpolator to provide an indication to said interpolator whether that picture data is required, the memory output also providing an indication to said interpolator of the coefficient required in the multiplying step.

19. A system according to claim 1, including input signal processor means provided between said first frame store and said non-real time storage means and adapted to reduce the quantity of data from said frame storage means prior to receipt by said non-real time storage means to effectively increase the storage capacity of the non-real time storage means, and output signal processor means provided after said non-real time storage means and adapted to increase the quantity of data from said non-real time storage means to effectively provide data corresponding to that originally captured by said first frame storage means.

20. A system according to claim 19, wherein said input signal processor means comprises a converter adapted to reduce the number of digital data samples from said frame storage means by reducing the effective data sample rate relative to that at the output of said first frame storage means.

21. A system according to claim 20, wherein the converter includes a separator for receiving digital video data from the spacially adjacent video lines and separating said data into high and low frequency components, a first adder for adding together the high frequency component from each line and a second adder for adding selected portions of the video data from said first adder to selected portions of the low frequency component to provide the reduction in data therefrom by a factor of two.

22. A system according to claim 21, wherein the separator comprises first and second digital filters for respectively receiving data from one of said two adjacent video lines.

23. A system according to claim 19, wherein the output signal processor means comprises a converter adapted to increase the number of digital data samples

from said non-real time storage means by increasing the effective data sample rate relative to that provided at its input.

24. A system according to claim 23, wherein said converter includes a separator for receiving digital data from two spacially adjacent video lines and separating said data into high and low frequency components, a first adder for adding together the high frequency component from each line and a second adder for adding the output from said first adder with the low frequency data from said separator to provide an increase in data therefrom by a factor of two.

25. A system according to claim 24, wherein the converter includes first and second digital filters and holding means are provided prior to the second adder to hold the low frequency data therefrom for at least one data sample period to repeat the low frequency data sample available to said second adder.

26. A system according to claim 19, wherein said signal processor means and said picture processor means comprises a shared processor incorporating an integral digital comb filtering decoder.

27. A system according to claim 1, wherein the picture processor means is adapted to manipulate the size of the picture on a line by line basis to effect a variable size change through different portions of the frame.

28. A system according to claim 1, wherein the picture processor means is adapted to manipulate the size of the still picture on a picture point by picture point basis to effect rotation of the picture relative to the normal frame position.

29. A system according to claim 2, wherein the second digital frame storage means is adapted to receive data on a number of pictures of reduced size so as to provide data therefrom corresponding to a frame of video made up of the reduced size pictures.

30. A system according to claim 1, wherein the picture processing means is provided prior to said non-real time storage means.

31. A system according to claim 1, wherein the picture processing means is provided after the non-real time storage means.

32. A system according to claim 31, wherein said picture processor means has an output connectible to the non-real time storage means to allow re-storage of digital data corresponding to reduced size pictures.

33. A system according to claim 1, wherein the first digital frame storage means is adapted to capture data on a moving picture to provide a still picture with full resolution on any parts of the picture where no movement is occuring.

34. A system according to claim 4, wherein the outputs of the additional frame storage means are received by fade control means adapted to produce a gradual change in selection between their outputs over a predetermined number of frame periods.

* * * * *

EXHIBIT 6

United States Patent [19]
Taylor et al.

[11] **4,172,264**
[45] **Oct. 23, 1979**

[54] **CONTROL ARRANGEMENT FOR VIDEO SYNCHRONIZERS**

[75] Inventors: Richard J. Taylor, Barnes; Peter C. Michael, Newbury, both of England

[73] Assignee: Quantel Limited, Berkshire, England

[21] Appl. No.: 873,037

[22] Filed: Jan. 27, 1978

[30] Foreign Application Priority Data

Feb. 1, 1977 [GB] United Kingdom 3947/77

[51] Int. Cl.² H04N 5/24
[52] U.S. Cl. 358/185; 358/183; 358/22
[58] Field of Search 358/185, 183, 93, 22

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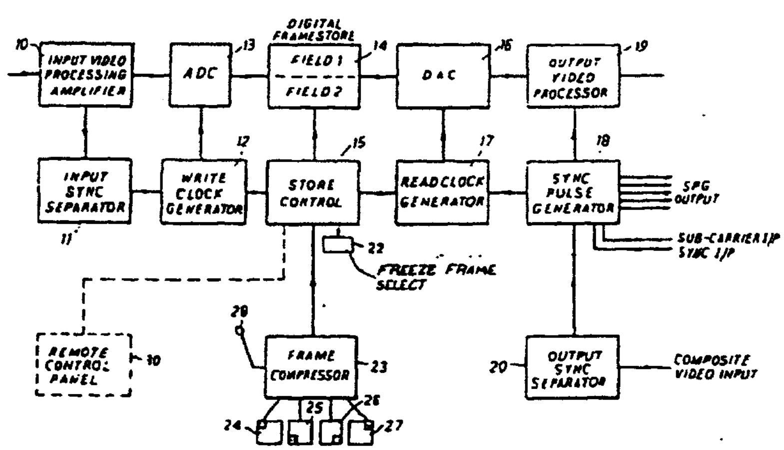
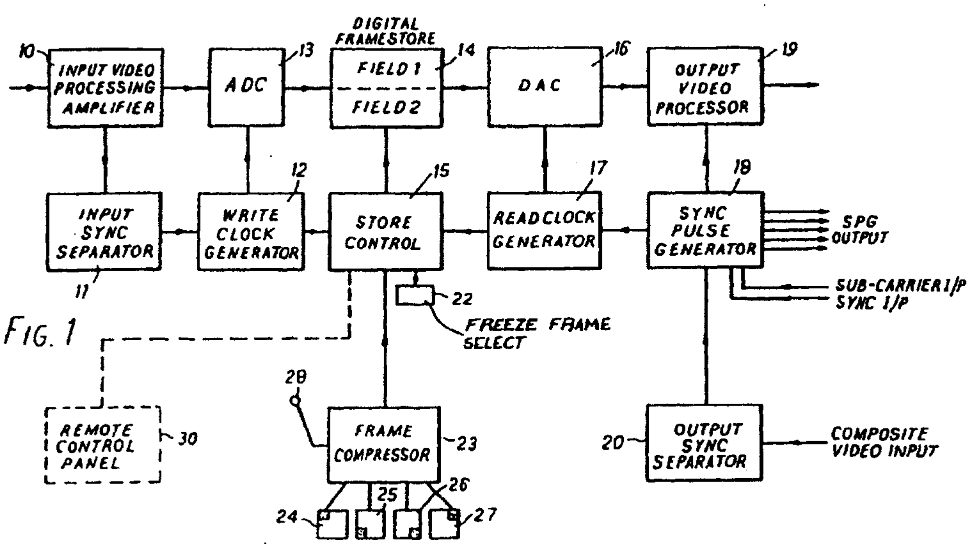
Primary Examiner—Howard W. Britton
Assistant Examiner—Edward L. Coles
Attorney, Agent, or Firm—Dowell & Dowell

[57] **ABSTRACT**

A video control arrangement for a synchronizer includes a joystick for moving the T.V. picture in at least one plane to a first selected position. A memory arrangement receives and holds information on the location of the first preselected position which can be recalled later to effect automatic movement of the T.V. picture to this preselected position.

10 Claims, 5 Drawing Figures





INPUT VIDEO PROCESSING AMPLIFIER
ADC
DIGITAL FRAMESTORE
FIELD 1
FIELD 2
DAC
OUTPUT VIDEO PROCESSOR
INPUT SYNC SEPARATOR
WRITE CLOCK GENERATOR
STORE CONTROL
READ CLOCK GENERATOR
SYNC PULSE GENERATOR
SPG OUTPUT
SUB-CARRIER I/P
SYNC I/P
FREEZE FRAME SELECT
REMOTE CONTROL PANEL
FRAME COMPRESSOR
OUTPUT SYNC SEPARATOR
COMPOSITE VIDEO INPUT
10
11
12
13
14
15
16
17
18
19
20
22
23
24
25
26
27
28
30

FIG. 1

FIG. 2

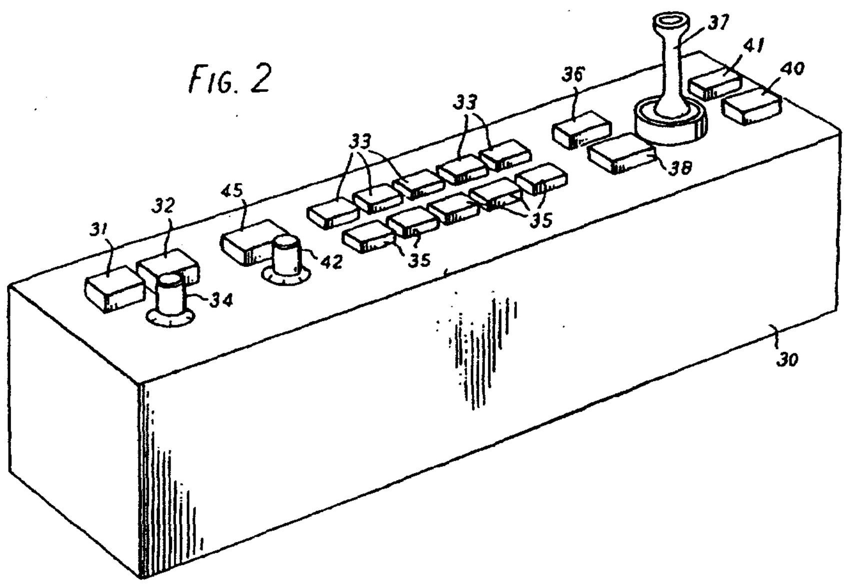


FIG. 3

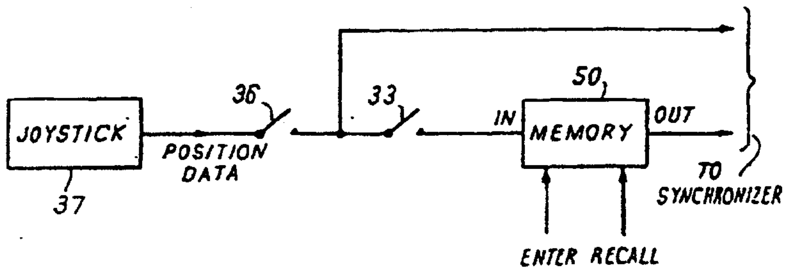
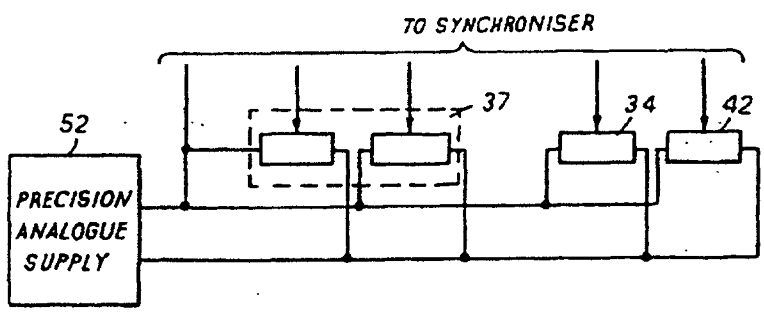

JOYSTICK
37
36
POSITION DATA
33
50
IN
MEMORY
OUT
ENTER
RECALL
TO SYNCHRONIZER

FIG. 4


TO SYNCHRONISER
52
PRECISION ANALOGUE SUPPLY
37
34
42

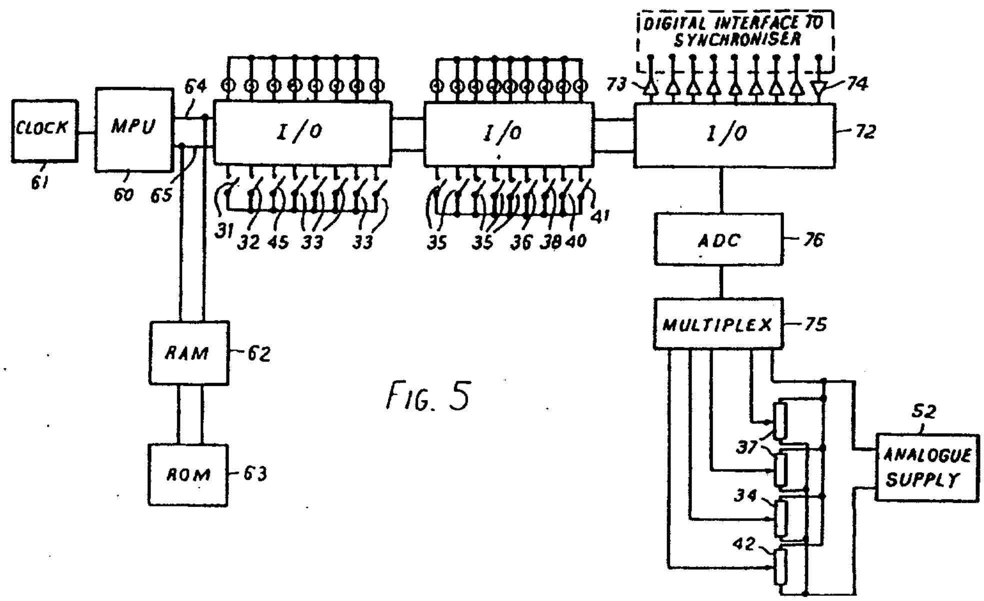

CLOCK
61
MPU
60
64
65
I/O
I/O
I/O
72
DIGITAL INTERFACE TO SYNCHRONISER
73
74
31
32
45
33
33
35
35
36
38
40
41
ADC
76
MULTIPLEX
75
RAM
62
ROM
63
ANALOGUE SUPPLY
52
37
34
42

FIG. 5

CONTROL ARRANGEMENT FOR VIDEO SYNCHRONIZERS

BACKGROUND TO THE INVENTION

The invention relates to synchronisers and more specifically to a video control arrangement for synchronisers.

Framestore synchronisers (e.g. Quantel DFS 3000) are now well known in various parts of the television world for example North America and Europe (see also for example British patent application Ser. No. 6588/76 or U.S. patent application Ser. No. 769,615, now U.S. Pat. No. 4,101,939).

In the DFS 3000, the synchroniser has the facility of picture freeze within the frame store (see also for example British patent application Ser. No. 6585/76 or U.S. patent application Ser. No. 764,148). The facility of frame compression to produce quarter size pictures is provided (see also for example British patent application Ser. No. 21024/76 or U.S. patent application Ser. No. 798,513, now U.S. Pat. No. 4,152,799). Movement of the compressed picture may be effected by means of a joystick control.

OBJECT OF THE INVENTION

An object of the invention is to provide additional control facilities for the synchroniser which may be provided at a position remote from the synchroniser.

SUMMARY OF THE INVENTION

According to the invention there is provided a video control arrangement for a synchroniser comprising; positioning means for moving the position of a T.V. picture in at least one plane to a first selected position; memory means for receiving and holding information on the location of said first preselected position and for recalling the location of this preselected position.

BRIEF DESCRIPTION OF DRAWINGS

The invention will now be described by way of example with reference to the accompanying drawings in which:

FIG. 1 shows the known synchroniser to which the control arrangement of the invention can be attached;

FIG. 2 shows typical manual controls of the unit;

FIG. 3 shows one arrangement for presetting and recalling the image position in the control arrangement of the invention;

FIG. 4 shows the joystick, undate interval and transition time controls; and

FIG. 5 shows an arrangement including a microprocessor for realising the functions of the FIG. 2 arrangement.

DESCRIPTION OF PREFERRED EMBODIMENTS

The arrangement for the known DFS 3000 synchroniser is shown in FIG. 1. A video input is received by processing amplifier 10 which feeds sync separator 11 controlling a write clock generator 12. The clock generator output is received by an analogue to digital converter (ADC) 13 which converts the video signal to digital form prior to storage in a frame store 14. The write clock generator 12 also has an output received by a store control 15 which controls the operation sequence of the store 14. The store output is received by digital to analogue converter 16 which is under the

control of clocks from read clock generator 17 receiving sync pulses from sync pulse generator 18. The analogue output of converter 16 is received by output processor 19 which provides the composite video output of the synchroniser. The sync pulse generator 18 is controlled by means of externally generated sub carrier and sync inputs directly or via an output sync separator 20 which receives a composite video signal.

The store control of the synchroniser has the facility of freezing the picture within the frame store (see also for example British patent application Ser. No. 6585/76 or U.S. patent application Ser. No. 764,148). The synchroniser has the facility of frame compression by only storing selected picture point samples so that if every other picture point is not stored (in both horizontal and vertical directions) a quarter sized picture is produced (see also for example British patent application Ser. No. 21024/76 or U.S. patent application Ser. No. 795,513). The frame compressor 23 allows this compressed picture to be stored in any one of four quadrants by means of selectors 24-27 which control the picture point counter addresses. In addition a joystick control 28 is provided which allows the quarter size picture to be moved anywhere within the normal picture frame area by defining the pertinent varying address as the stick is moved.

The remote control arrangement 30 of the invention is connectable to the store control of the known synchroniser to provide the standard functions just described together with additional functions at a position remote from the synchroniser (e.g. in the studio mixer) by a distance of up to several hundred feet if required.

A typical layout for the manual controls of unit 30 is shown if FIG. 2.

A frame freeze button 31 is provided for freezing captions. A field freeze button 32 is provided for stopping fast moving objects on the picture. In addition an update control 34 is provided which allows a variable update interval to be selected by the producer to automatically update the frozen picture between a rate of say once per second to infinity (i.e. hold).

Five preselect buttons 33 are provided for the compressed picture position. These buttons not only select the compressed function when depressed but also have the capability to memorize positions previously chosen at the beginning of the T.V. programme so that these can be recalled by the producer when required and thus allow rehearsal of a programme prior to transmission in the confidence that when be moves from event to event on air the chosen sequence will be faithfully reproduced. The chosen position is recalled merely by pressing the appropriate button and the cancellation of this effect to normal size and position is effected by depressing the appropriate button once again.

The memory facility is actuated during rehearsal in conjunction with 'live' button 36 and joystick positioner 37. The picture position is determined by varying the joystick 37 with live button 36 depressed. If one of the preselect buttons 33 is also depressed the position of the joystick is remembered for recall later.

It is also possible to move and memorise a full frame of video by means of joystick 37 by depressing live button 38 and one of the five preset buttons 35 in a similar way to compressed frame. By only depressing the live button 36 or 38 it is possible to rely only on live position control without using the preselect facilities of buttons 33 and 35. Two buttons 40 and 41 are provided

to switch off respectively the X and Y axes of the joystick to allow a smooth live single dimentional pan or tilt.

A transition time control 42 is provided to allow the producer to select the rate of pan or tilt from one preselected position to another. The rate can be varied typically from instantaneous to a time of several seconds. Alternatively the rate of velocity may be varied.

An auto key button 45 is also provided. The auto key facility is provided to make life easier for the camera man. The control is able to measure the centre of the chroma key area when the chroma key signal is fed into the synchroniser and computes the appropriate position for the compressed image to be centred over the key signal so that if the camera pans the compressed image automatically follows. Thus auto key is used where a chroma key signal is being fed to the synchroniser and the producer has approximately centred a compressed picture over the key area using one of the five preselector buttons. Pressing the auto key button 45 will ensure that the compressed image is automatically centred over the key area even if this key area should move. The various buttons described above may incorporate a lamp to clearly indicate that a button is depressed.

A circuit arrangement suitable for the compressed picture position presetting of FIG. 2 is shown in FIG. 3.

The position data from joystick control 37 can be passed via live switch 36 directly to the synchroniser so that the joystick operates in the known live mode. If however the preset switch 33 is closed, the position data is fed into a memory 50 where it is stored. When the position data is recalled this is passed to the synchroniser to cause movement to this position to be implemented. Enter and recall for the memory can be arranged to be actuated respectively with the preset switch 33. The memory may be analogue or digital depending on the type of output provided by the joystick and the synchroniser input. To provide the requirements of the FIG. 2 arrangement five such switches 33 and memories 50 would be required for the compressed picture position and five similar arrangements for the full frame position.

Although such a system can be constructed solely from known hardware elements it is more convenient to use a microprocessor system with related circuitry to effect the above arrangements and such a system will be described later with reference to FIG. 5.

FIG. 4 shows analogue arrangements for the joystick, update intervals and transition time controls.

Joystick control 37 comprises two variable resistors one for vertical and horizontal position respectively. Update interval control 34 comprises one variable resistor which controls a simple timing circuit (not shown) that operates on the freeze lines. The transition time or velocity control 42 also comprises a variable resistor and this operates a simple ramp circuit (not shown) that constrains the rate at which the voltage that controls the position is allowed to change from one location to another. The controls receive a voltage from a precision analogue supply 52 which may be in the control unit or taken from the synchroniser.

The use of a microprocessor system to effect the above control functions is shown in FIG. 5. The heart of the system is a microprocessor unit (MPU) 60 (e.g. Motorola 6800). A random access memory (RAM) 62 (e.g. Motorola 6810) is connected to the MPU which acts as working space for the programme, which processor programme is contained in read only memory (ROM) 63 (e.g. Motorola 6830). The memories are connected to the MPU by common address bus 64 and common data bus 65. The various switches 31, 32, 45, 33, 36, 35, 38 (and their associated lamps) are connected to I/O circuits 68, 69 (peripheral interface adaptors e.g. type 6820). These interface adaptors are connected to the MPU via common buses 64, 65. An additional adaptor 72 is provided together with line drivers 73 and line receivers 74 to provide the necessary digital interfacing to and from the synchroniser.

The analog controls of FIG. 4 are now included in FIG. 5 and are connected to the microprocessor system via a multiplexer 75 and an analogue to digital converter (ADC) 76 which converts the analogue signal to digital form to allow purely digital interfacing to and from the synchroniser of all required functions.

The programming of microprocessors is well known and so will not be described in detail.

The microprocessor programme is written in such a way that the pushing of the relevent selector button and moving the joystick effects memorising of that location for the compressed or full frame picture to allow the picture to move from one position to another at a rate chosen by the variable transition control.

Another advantage of the microprocessor system is that the programme can be written in such a manner that non-linear movement of the picture from one stored location to another is possible. In this way picture movement similar to that achieved by the camera man when having to accelerate and decelerate the mass of his camera can be obtained thereby creating greater realism.

The variable transition control is achieved by causing the programme to incrementally count from one location to another. Clearly if this count is fed as the address of the picture to the synchroniser, smooth movement between, instead of an instantanious jump from one location to another, is obtained. The concept of non-linear movement can be realised by producing a non-linear transfer function in the programme space so that linear vectors demanded by the main programme are 'bent' to move slower at the start and finish of the process.

We claim:

1. A video control arrangement for a synchroniser comprising:

picture positioning means for moving the relative frame position of a T.V. picture to a first selected position;

memory means for receiving and holding information on the location of said first preselected position and for recalling the location of this preselected position.

2. A control arrangement according to claim 1 wherein said memory means is for holding information on a full size picture.

3. A control arrangement according to claim 1 wherein said memory means is for holding information on a compressed picture.

4. A control arrangement according to claim 1 wherein auto key means are provided to ensure automatic centering of the position of the T.V. image.

5. A control arrangement according to claim 1 wherein the control arrangement can be provided remote from the synchroniser via coupling means.

6. A control arrangement according to claim 1, wherein a plurality of memory means are provided to receive and hold information on a plurality of preselected positions.

7. A control arrangement according to claim 6 wherein transition means are provided to effect movement of said picture from one preselected position to another in a predetermined period.

8. A control arrangement according to claim 7 wherein said transition means are variable to provide movement over a predetermined period range.

9. A control arrangement according to claim 1 wherein freeze control means are provided to freeze the picture for a predetermined period and wherein update means are provided to update the frozen picture after a predetermined period.

10. A control arrangement according to claim 9 wherein the update means is variable to provide a variable update period.

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